Concrete

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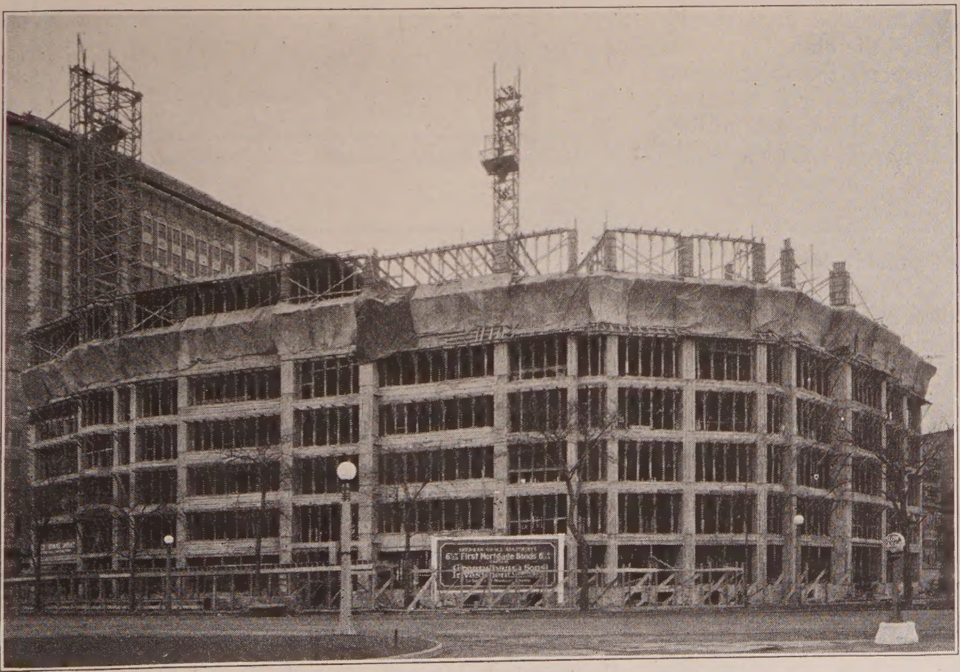
A Construction Superintendent's Experience With Winter Concreting

> ***There is no "construction season" in our company.***
>
> ***We do not even slow down on our rate of production.***
>
> ***Our forces placed as high as 40 cubic yards of concrete an hour, a creditable rate even for warm weather.***
>
> ***We learned that fresh concrete will harden more rapidly if the salamanders are placed at a level well above the floor.***

By C. T. MONTAGUE
Construction Superintendent
With the Avery Brundage Co., Chicago

THERE is no need or excuse for stopping concrete work in winter. To be sure, certain precautions must be taken when the weather is cold, just as certain other precautions must be taken in hot weather, or in excessively wet weather. The important thing to keep in mind is that "construction season" is an expression that should be dropped from the vocabulary of the building industry.

In our own company we have no "construction season," although our work involves the placing of enormous quantities of plain and reinforced concrete. When the season for cold weather arrives we are prepared to provide the necessary protection to freshly placed concrete, through the liberal use of tarpaulins and salamanders. It costs a little extra money to furnish this protection; but it would cost much more to disband one's organization, letting the equipment lie idle and allowing the foremen and key men to be dispersed and perhaps picked up by other construction companies. The better class of workmen appreciate the greater regularity of employment made possible by the continuation of work during the winter months, and



The Sheridan-Grace Apartments, in February, 1927. Tarpaulins, with salamanders, furnish sufficient protection against cold weather in Chicago's climate their loyalty to the company is increased accordingly. This statement is not based on theory, for some of our foremen and key men have been with us for years.

We do not even slow down on the rate of production in placing concrete in winter. On the Sheridan-Grace Apartment building in Chicago, built last winter, our forces placed as high as 40 cu. yds. of concrete an hour, a rate that would be considered creditable enough in warm weather.

In winter as well as in summer we do all our mixing in a protected central mixing plant. The concrete is elevated by hoists in the usual manner, delivered from the hoist to a convenient place by a short length of chute, and distributed with wheelbarrows or buggies.

The temperature of our freshly deposited concrete is about 55 degrees Fahrenheit. During very cold weather this temperature of concrete is attained by heating the water to around 100 to 110 degrees, and heating sand and gravel so that the temperature when going into the mixer is about 70 degrees. Water is heated by steam coils run through barrels, and aggregates with similar coils in the bins.

A temperature of 55 degrees for freshly placed concrete is high enough, for not until it falls below 50 degrees does the rate of hardening begin to slow down. To get a temperature much higher than 55 degrees it would be necessary to heat the mixing water to a point where it would be harmful to the cement. It is not generally known among men on construction work that cement can be seriously damaged by using mixing water that is too hot.

Position of Salamanders

Much of our practice in placing concrete during cold weather has been developed from our own experiments. Several years ago we found that the position of the salamanders had much to do with the rapidity of hardening. To illustrate, suppose that a floor has been concreted with heated materials, that the fresh concrete has been covered with tarpaulins, that the story below has been closed in and salamanders are in place on the floor of that story. From our experiments we learned that the fresh concrete will set and harden more rapidly if the salamanders are placed at a level well above the lower floor. This is only what might be expected, for as the salamanders approach the newly concreted floor the air becomes warmer at the under side of the slab.

In future work we expect to suspend the salamanders from the shoring timbers of the freshly-concreted floor, raising and lowering them with light chains and pulleys to facilitate firing. Two men will handle thirty salamanders.

Test Specimens Show Condition of Concrete

We have learned also that the outside face of a spandrel beam is hard to keep warm. Test specimens placed in that location will disclose whether the concrete in the beam is actually hardened or only frozen hard. This difficulty is greatly increased along the windward side of a building when a strong wind is blowing.

Test specimens of concrete must be placed at many points on the newly-concreted floor and must be cured under the same conditions to which the floor concrete is subjected. On structures of considerable height it is our practice to leave shores in place until test specimens in the most unfavorable locations indicate that the strength of the concrete is around 1,300 lbs. a sq. in.

Closing in a building with ship-lap or other boarding is an unnecessary expense, in the latitude of Chicago. Tarpaulins are sufficient for the purpose. In either case it will be necessary to heat the aggregates and mixing water and to keep up the fires in salamanders, so that little advantage is gained from the use of boarding, and the expense is of course much greater than if tarpaulins are employed.

The high quality of concrete that may be obtained in winter weather was well demonstrated by load tests on the first floor of the Sheridan-Grace Apartments, facing Lake Michigan on Sheridan Road, at Grace St., in Chicago. This floor was concreted in February, 1927, on a day when the temperature was 6 degrees above zero and a strong wind was blowing off the lake. The city building inspector who supervised the tests had a panel loaded to 450 lbs. a sq. ft., nine times the live load for which the floor was designed, although the Chicago building ordinance required a test load of only twice the combined dead and live load for which the building is designed. The test panel showed no signs of distress, and in fact the deflection was not measurable. The excellent quality and appearance of the structural concrete in that building proves again the wisdom of our policy of refusing to stop concrete work in winter.

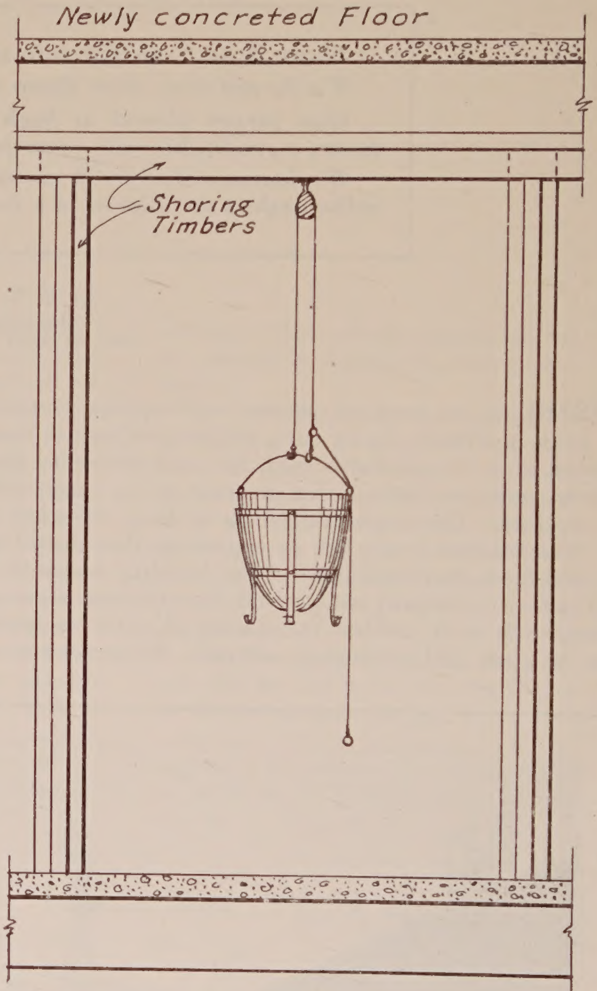


FIGURE 1 – SALAMANDER SUSPENDED MIDWAY BETWEEN FLOORS

Meeting of Highway Research Board in Washington

The Highway Research Board of the National Research Council is holding its seventh annual meeting on December 1st and 2nd, at Washington, D. C.

Reinforced Masonry Walls That Will Resist Earthquakes and Storms

A Suggested Method of Reinforcing Masonry Walls So They Will Withstand Wind and Earthquake—Typical Design of Such Walls — Method of Construction—Advantages

THE St. Louis tornado of September 29 has again brought the attention of the building industry to the weakness of masonry walls as ordinarily built. It has long been said, as a result of conclusions drawn from previous storms and from earthquakes, that masonry walls reasonably well built will resist these two great forces of nature. The building fraternity is again confronted with the spectacle of wholesale failures of masonry construction.

Furthermore, these wholesale failures have occurred in a large city, where a building inspection department has been functioning for many decades, and where the quality of brick masonry is at least as good as the average. All buildings in the affected area were built under ordinary circumstances, not in a boom period when "everything goes." It mattered little whether the buildings were new or old, whether they were built by the supposedly careless workman of the present day or the supposedly conscientious workman of years ago. They all failed, proving thereby that clay brick masonry, like other kinds of masonry, is not dependable unless intelligent attention is given to details that ordinarily are overlooked.

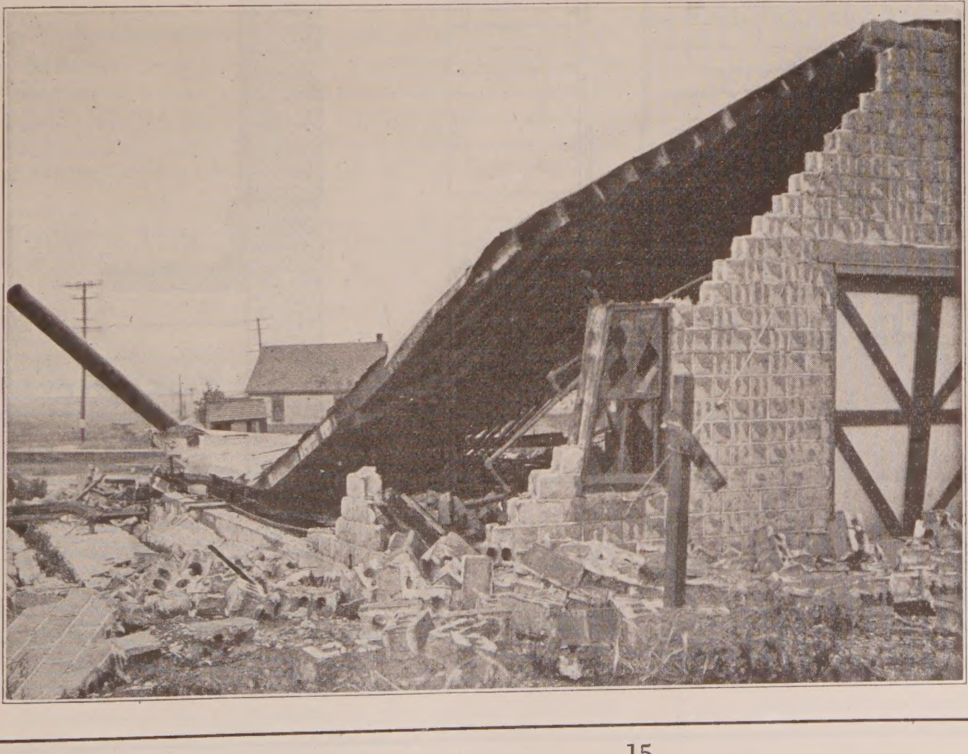
Masonry Walls Must Be Reinforced

The truth of the matter is that when a masonry wall is built of sound materials and by competent workmen, security against destruction by storm or quake is only half accomplished. The other half, to which equal attention must be paid, is engineering design. There must, of course, be proper bond between the individual units in the wall and between the facing material and the backing. But that is not all. Some method must be employed that will increase the strength of the walls and tie the parts of the building into a unit. In a word, there must be an approach to the structural frame employed in large buildings.

This may be accomplished by a method that has for some years been in vogue in southern California and is now being introduced in several cities in Florida. The method involves but little additional cost. It consists of building a light structural frame of reinforced concrete as an integral part of the wall. The frame consists of reinforced concrete wall girts just below each floor level and at the top of the wall, and vertical posts of the same material, spaced 5 to 8 feet apart and connecting the girts to each other. Typical details are shown in the line illustration.

Method of Construction

Study of the illustration will readily suggest the sequence of construction. Assuming that the foundation wall is of concrete, no girt will be required at the first

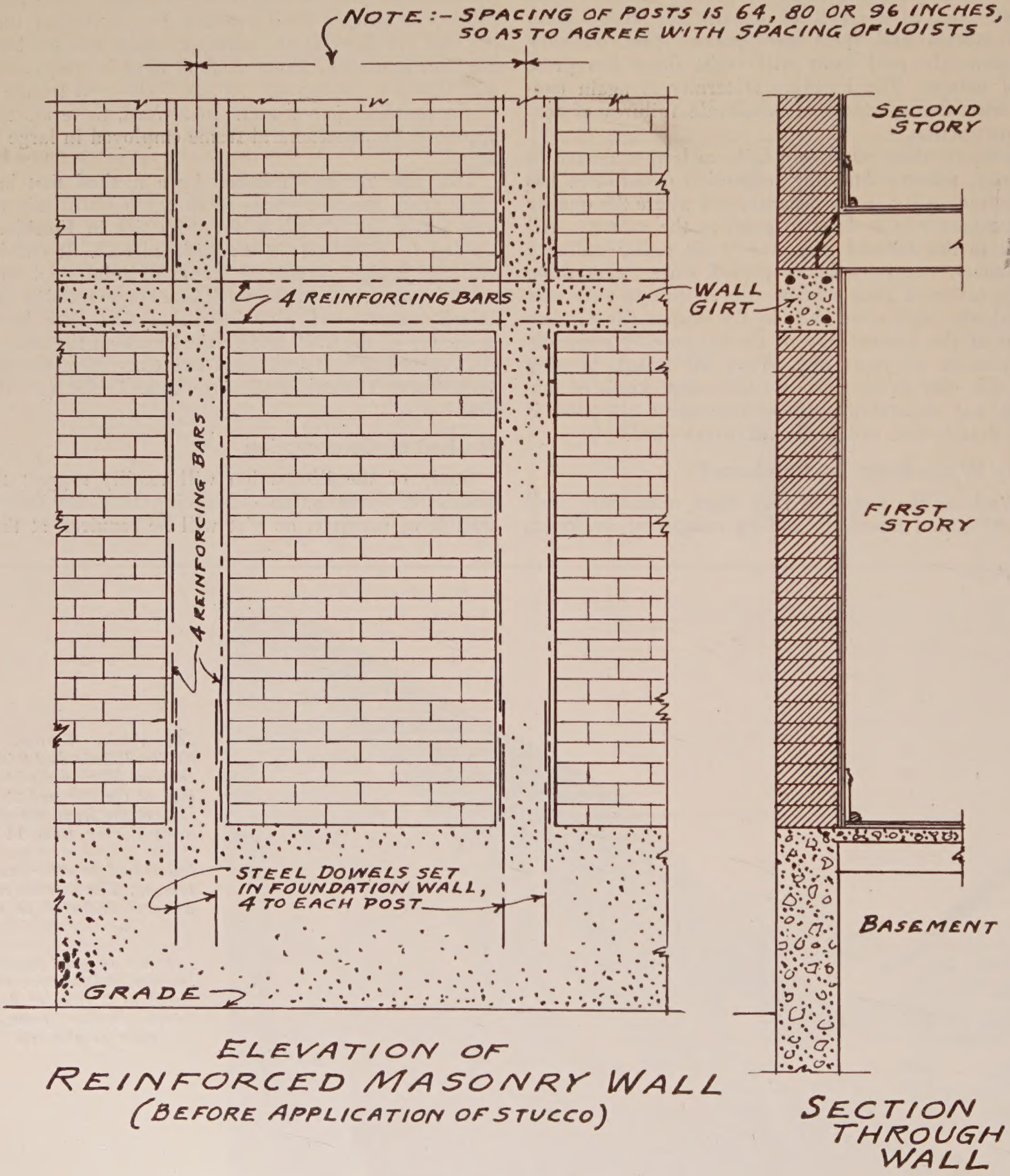


The Venice Garage, at Venice, Illinois, had 8-inch concrete block walls 14 ft. high at the rear and 20 ft. high at the front, the side walls sloping from 14 to 20 ft. There were no pilasters and no other cross-bracing. The wooden roof was not anchored to the wall. The mortar was of lime, with some cement, and not of good quality. Interior roof supports consisted of 2 rows of 4 by 4-inch wooden posts, 3 posts to the row floor level. Dowels of reinforcing steel will be set in the foundation wall wherever vertical posts are to be located. The masonry in the first story wall is then laid, but at each set of dowels a space is left for a post. Reinforcing bars are then set in these spaces, of sufficient length to extend through the reinforced concrete wall girt at the second floor level, so as to serve as dowels for the posts in the second story wall. Form boards are placed against the inside and outside face of the wall, and the posts are concreted. Form boards then are placed for the wall girt at the second floor level, steel bars are secured in place and the girt is concreted.

The masonry of the second story is then laid and the process is repeated. Since the masonry is laid before the posts and wall girts are concreted, a perfect key is formed between the frame and the masonry. The concrete fills all irregularities and unfilled joints in the masonry, thereby forming a much better anchorage than where the structural frame is built first and the wall panels are filled in afterwards.

Advantages of a Structural Frame

The completed structure differs from a building of the structural frame type in the sense that the reinforced concrete frame within the wall is not figured to carry the entire load. Its function is that of confining the masonry


NOTE:– SPACING OF POSTS IS 64, 80 OR 96 INCHES, SO AS TO AGREE WITH SPACING OF JOISTS
4 REINFORCING BARS
WALL GIRT
4 REINFORCING BARS
STEEL DOWELS SET IN FOUNDATION WALL, 4 TO EACH POST
GRADE
SECOND STORY
FIRST STORY
BASEMENT

ELEVATION OF REINFORCED MASONRY WALL (BEFORE APPLICATION OF STUCCO)

SECTION THROUGH WALL

and compelling the wall to act as a monolithic unit. It ties the building horizontally and vertically, and it prevents the breaking away of that first brick or block that starts the trouble.

Because the reinforced concrete frame is exposed, cement stucco is the logical exterior finish, at least for individual dwellings. Exposure of the frame on side and rear walls would not be objectionable in an apartment house or a business building, but the front would require a stucco finish.

A notable building in which this form of wall construction is utilized is the residence of Dr. I. Eisner, in Los Angeles, built in 1925 and described in CONCRETE for February, 1927. At the time of its construction this building was said to be the largest concrete masonry residence in the United States. The exterior walls are of concrete Stone-tile, reinforced with a concrete frame of the kind described in the foregoing paragraphs. The exterior is coated with portland cement stucco, which completely covers and conceals the frame. The architect of the Eisner residence is Gordon B. Kaufmann, of Los Angeles.

The Eisner residence, with walls of Stone-tile, is reinforced with a concrete frame

County Highway Officials to Hold First Meeting at A. R. B. A. Convention

Plans for the twenty-fifth anniversary convention of the American Road Builders Association are making great strides in filling the four days of the convention with topics of interest.

Monday, January 9th, will be manufacturers' day and will give manufacturers opportunity to present their newly-developed products to the visiting members of their own organizations from different parts of the United States.

Tuesday, January 10th, will be Governors' day. Governor A. V. Donahey of Ohio will be honorary chairman of the day.

Wednesday, January 11th, will be Pan-American day and the program is given over to the special problems important in all countries, as well as the development of closer relations with the Pan-American countries, especially in regard to their highway programs. Dr. E. Gil Borges, Assistant Director of the Pan-American Union, is Chairman of Pan-American day and his close identification with the Pan-American countries assures the greatest success for this day.

Thursday, January 12th, is County Highway Officials' day. The newly-organized division, under its president, Thomas J. Wasser, will have charge of the program for this day. The County Division is functioning through eight Standards Committees, covering the county highway problems. Papers and reports of these committees will constitute the program of this day and all activities will be carried on by county officials. The County Highway Officials' Division is growing fast and gaining a large membership. Several hundred contact men have already been appointed and will act as delegates to the convention.

Road Show Day

Friday, January 13th, will be given over entirely to the road show, so that engineers, officials and contractors who have devoted their time to the papers at the convention will have an opportunity to visit the road show and inspect and compare the latest developments in equipment and materials.

All hotel reservations must be made through the Hotel Committee, Mr. A. J. Kennedy, Chairman, 304 Chamber of Commerce Building, Cleveland, Ohio. Assurance has been received that all attending the convention will be suitably provided for in hotels. Hotel reservations should be made direct to Chairman Kennedy by letter or on a blank form provided for the purpose.

There have been rumors to the effect that the hotel accommodations in Cleveland would not be sufficient to take care of those attending the convention and road show. The Hotel Committee announces that the hotel facilities in Cleveland will be ample to take care of all who attend the convention.

A housing bureau will function up to the middle of convention week. Reservations should, of course, be made as early as possible.

Due to the increasing number of members in the American Road Builders' Association, the membership has been divided into five divisions. These different divisions will be distinguished by different colored badges, obtained when registering at the convention. The Division of County Highway Officials includes all engineers and officials associated in county work. The Division of Engineers and Officials includes all engineers and officials in state or municipal work or in private practice. The Division of Highway Contractors includes all contractors active in highway construction. The Manufacturers Division comprises manufacturers making a specialty of products used in highway work and includes primarily the exhibitors. The membership-at-large includes all classifications not covered in the four other divisions.

Membership Divisions

Reduced railroad fares have been granted to those attending the convention. When purchasing ticket to Cleveland, a certificate (not receipt), should be asked for which will entitle the purchaser to a return ticket at one-half price.

There will be separate headquarters both at the Public Auditorium and at the Hollenden Hotel for the State Highway Officials, City Officials, County Highway Officials and Highway Contractors. All delegates are invited to register and use these headquarters while at the convention. Attendants will be in charge at all times.

Estimating Concrete Quantities For Water-Cement Ratio Mixes

Some Practical Tables to Be Used for Estimating the Quantities of Materials Needed for Quality Controlled Concrete

By CHAS. F. DINGMAN

GENERAL acceptance of the water-cement ratio by contractors as a practical means of proportioning concrete mixes has been very much retarded by the apparent difficulty of estimating in advance the quantities of materials which will be required to produce a given yardage of concrete.

While much has been published on the methods of designing the mixtures to obtain specified strengths under necessary conditions of workability, practically nothing has been said that would indicate, to a contractor preparing an estimate, how he might determine what it will cost him to produce the concrete that will have the required properties.

While absolutely accurate estimating, within the usual limits of building estimating, is hardly practicable until the aggregates to be used on any given piece of work are known and trial batches have been made and tested, it is possible to make fairly close estimates upon the basis of the figures given below. The errors, where any occur, will tend to be on the side of safety, since the actual quantities of cement, which is the expensive ingredient, will tend to be less rather than greater than the quantities given in the tables.

As is usual in most kinds of concrete work, the following facts apply to concrete proportioned by the water-cement ratio:

Coarse Aggregate Constant

The quantity of coarse aggregate is practically constant for all mixes and strengths, being about the same as the final quantity of concrete as measured after compacting in the forms. Under certain conditions, due to bulking when being handled, the quantity purchased will be slightly greater than the quantity of concrete produced.

The quantity of sand, or fine aggregate, is practically constant for all mixes and strengths but varies in accordance with the percentage of voids in the coarse aggregate, being essentially the amount required to fill those voids.

The amount of cement, which is, of course, the most important element in determining the cost of the concrete, varies with the strength required, the softness of the mix, as indicated by the slump test, and the size of the coarse aggregate used.

Materials Required per Cubic Yard of Concrete

Designed 28-day Strength in Lbs. per Sq. In.	Bags of Cement — Using Aggregate Having Maximum Size of —				
	3/4"	1"	1½"	2"	2½"
3" to 4" Slump					
1,500	4.7	4.2	4.0	3.6	3.4
2,000	5.8	5.2	4.8	4.4	4.1
2,500	7.1	6.3	5.8	5.4	4.9
3,000	8.4	7.5	7.1	6.8	6.3
3,500	10.8	9.7	9.0	8.4	8.0
4,000	13.5	12.3	11.3	10.5	9.7
5" to 8" Slump					
1,500	5.7	5.2	4.7	4.4	4.0
2,000	7.3	6.8	6.3	5.8	5.2
2,500	9.0	8.4	7.9	7.1	6.4
3,000	11.2	10.4	9.7	9.0	8.4
3,500	14.4	13.5	12.3	11.3	10.4
4,000	20.1	18.0	16.9	15.9	15.0
Tons of Washed Sand Required for Any Strength or Slump	0.29	0.37	0.39	0.4	0.45
Tons of Coarse Aggregate,					
If Gravel	0.93	0.94	0.95	0.96	0.96
If Trap Rock	0.89	0.90	0.91	0.92	0.92

For all practical purposes, a figure of 0.95 ton of gravel or 0.91 ton of trap rock might be used, and these figures will be found to afford a much more effective means of estimating, being based entirely on the weights of the materials, than the old tables which gave the quantities of aggregates in cubic yards of packed, dry materials, while the materials as delivered and measured are usually damp and loose, which necessitates the purchase of greater quantities than those estimated from the tables.

When sand and gravel, purchased on the basis of damp and loose measurement, are to be used, the following quantities must be estimated:

Required	*Maximum Size of Aggregate Allowed*				
	3/4"	1"	1½"	2"	2½"
Cu. Yds. Sand	0.41	0.52	0.54	0.56	0.63
Cu. Yds. Gravel	0.99	1.00	1.00	1.01	1.01

The slumps used for these tables are those suitable for ordinary reinforced concrete building construction, 3 to 4 inches being that recommended for ordinary walls, slabs and beams, and 5 to 8 inches being that recommended for thin walls and columns.

Of course, when stiffer concrete can be placed without adding excessively to the labor cost, the quantity of cement can be reduced by as much as 10 or 15 per cent of the tabular quantities, while necessity for a thinner concrete will cause corresponding additions to those quantities.

The labor may be estimated by the customary methods, since the total quantity of all materials to be handled can readily be determined as above, and the yardage of mixed concrete is known.

Assistant Director of Highway Research Board Resigns

Professor S. S. Steinberg, head of the Department of Civil Engineering at the University of Maryland, has resigned as Assistant Director of the Highway Research Board, National Research Council, in order to return to his duties at the university and to practice as consulting engineer on road and street construction. His offices are now at College Park, Maryland.

Light-Weight Concrete Floors for Dwellings

RECENTLY there has been a remarkable increase in interest in light-weight aggregates. Though light-weight aggregates have been used to a limited extent for some time, they are still only slightly known to most concretors.

Volumes of technical studies have been written and published on this subject. But for the most part such studies have been made with respect to the use of light-weight aggregates in building concrete ships, a branch of the industry that was of especial interest to only a few concretors.

In the literature on the uses of light-weight aggregates are many things that are of practical value to the progressive concretor of today. But it is no small task to dig up this material, sift it, classify it and arrange it so that it will be of immediate use to the concretor who is today considering the use of light-weight aggregates in his work.

"Concrete" is fortunate to be able to present to its readers just such a simplified, boiled-down study of the subject of light-weight aggregates with especial reference to their uses in building concrete floors for dwelling houses. The facts brought out are equally applicable to many other branches of the concrete industry in which light-weight aggregates will play an increasingly important part.

This article is based on a thesis submitted by William Curran Cavanagh, Jr., to the faculty of George Washington University for a degree of Master of Science in Civil Engineering. It is brimful of practical information on the subject of light-weight aggregates that will be of value to every concretor.

IT is the purpose of this article to present data regarding the strength, weight, and other qualities of concrete made from different light-weight aggregates, with sketches and designs of three types of floor construction in general use. The selection of any one of the various aggregates discussed will depend upon the cost and availability of the material in the locality in which it is to be used.

The discussions and designs presented were confined to seven aggregates, selected primarily for their lightness, but possessing various other qualities such as low cost, strength, workability and availability. Some of the mixes used in the tests are not those ordinarily used, but as these were the only tests available, they were presented to give an idea of the strength and weight of the concrete made from some of the aggregates.

The seven aggregates presented were taken up in the order of their lightness. They include: pumice, coke, burnt clay, cinders, crushed brick and slag. A table showing the mix, 28-day strength and weight per cubic foot is given for each aggregate, with a brief note as to the quality of the aggregate and the concrete made from it.

Concrete made from pumice is a very excellent fire resistant. Care must be taken to prevent too wet a mix because segregation of the aggregates will occur due to the lightness of the pumice, especially when it is combined with other silicious materials.

Mix	Aggregates	28-Day Comp. Strength lbs. per sq. in.	Weight lbs. per cu. ft.
1:1:2	Cement Pumice sand below ¼-in. Pumice, ¼-½-in.	2300	94
1:1:2	Cement Sand Pumice, ¼-½-in.	2685	110

Hard Coal Coke

Mix	Aggregates	28-Day Comp. Strength lbs. per sq. in.	Weight lbs. per cu. ft.
1:1:2	Cement River Sand Coke	3680	111
1:1:2	Cement Fine Coke Coke	3860	100

Burnt Clay

Burnt clay was the aggregate selected by the U. S. Emergency Fleet Corporation as best suited for use in the construction of concrete ships. It is an artificially burned clay, heated to a high temperature until it bloats, forming small non-connecting cells. It is prepared commercially at the present time, being supplied in graded sizes, ready for use.

Mix	Aggregates	28-Day Comp. Strength lbs. per sq. in.	Weight lbs. per cu. ft.
1:1:2	Cement Clay Sand below ¼-in. Clay, ¼-½-in.	3600	105
1:1:2	Cement Clay Sand below ¼-in. Clay, ¼-½-in.	4350	106

Cinders

In order to meet the usual required strength of 2000 pounds per square inch ultimate strength at 28 days, a richer mix than that indicated in the following table will be required. Cinders suitable for aggregate can be found in most any locality at a reasonable cost. Cinder concrete should be used only in locations where dryness is assured.

Mix	Aggregates	28-Day Comp. Strength lbs. per sq. in.	Weight lbs. per cu. ft.
1:2:4	Cement River Sand Cinders	1647	118

Crushed Brick

Crushed brick can readily be obtained by using the scrap and inferior brick from brick yards and crushing them. Sometimes old brick from dismantled buildings are used. The unit weights of the crushed brick and cinder concretes are so close, that for the purposes of design an average weight of 117 pounds per cubic foot was selected and used in the slabs.

Mix	Aggregates	28-Day Comp. Strength lbs. per sq. in.	Weight lbs. per cu. ft.
1:1:2	Cement Sand Crushed Brick, ¼-½-in.	4000	124
1:1:2	Cement Brick Sand Crushed Brick, ¼-½-in.	4400	116

Slag

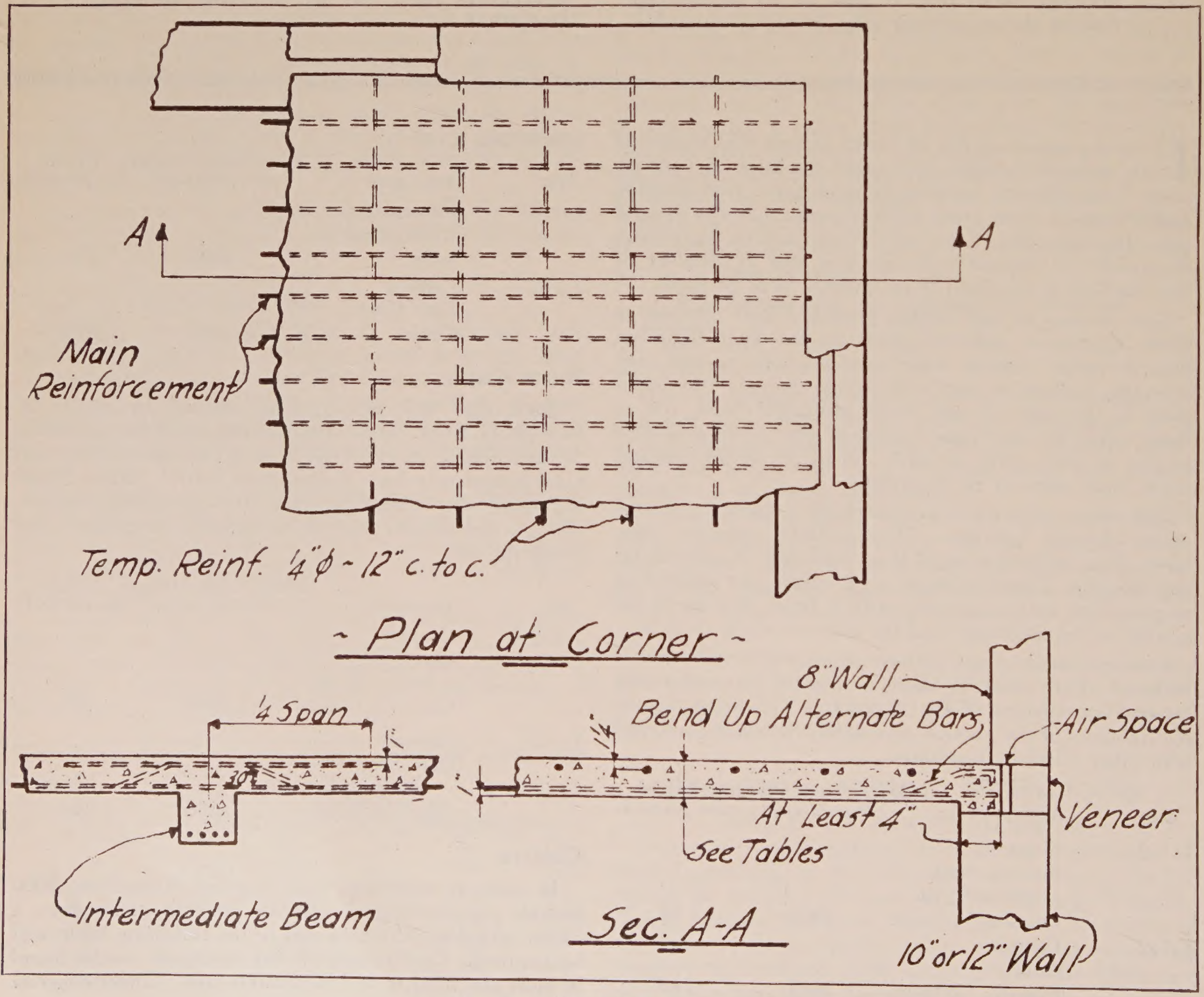
Mix	Aggregates	28-Day Comp. Strength lbs. per sq. in.	Weight lbs. per cu. ft.
1:2:3	Cement River Sand Slag	3462	134
1:2:3	Cement Slag Sand Slag	2029	127
1:2:3	Cement Granulated Slag Slag	1670	121

Granulated slag does not make a good fine aggregate because the grains are weak and brittle and because its glossy surface prevents the retention of the moisture necessary for a smooth mix and a good bond between the cement and the aggregate.

Three Types of Floor Construction

The use of these aggregates for building the three types of floor construction in general use were studied and the results are presented in the following sketches and tables.

The most simple type is the solid slab. In this type reinforced concrete slabs are carried across the room spans, the thickness of the slab depending upon the span. Usually a thickness sufficient for the longest span is car-



Details of solid slab floors

ried throughout the house to simplify form construction.

Tables 1 to 5 inclusive show the slab thickness, size and number of reinforcing bars and the spacing of the bars for spans up to 16 feet, for the various types of lightweight aggregates when the solid slab is used.

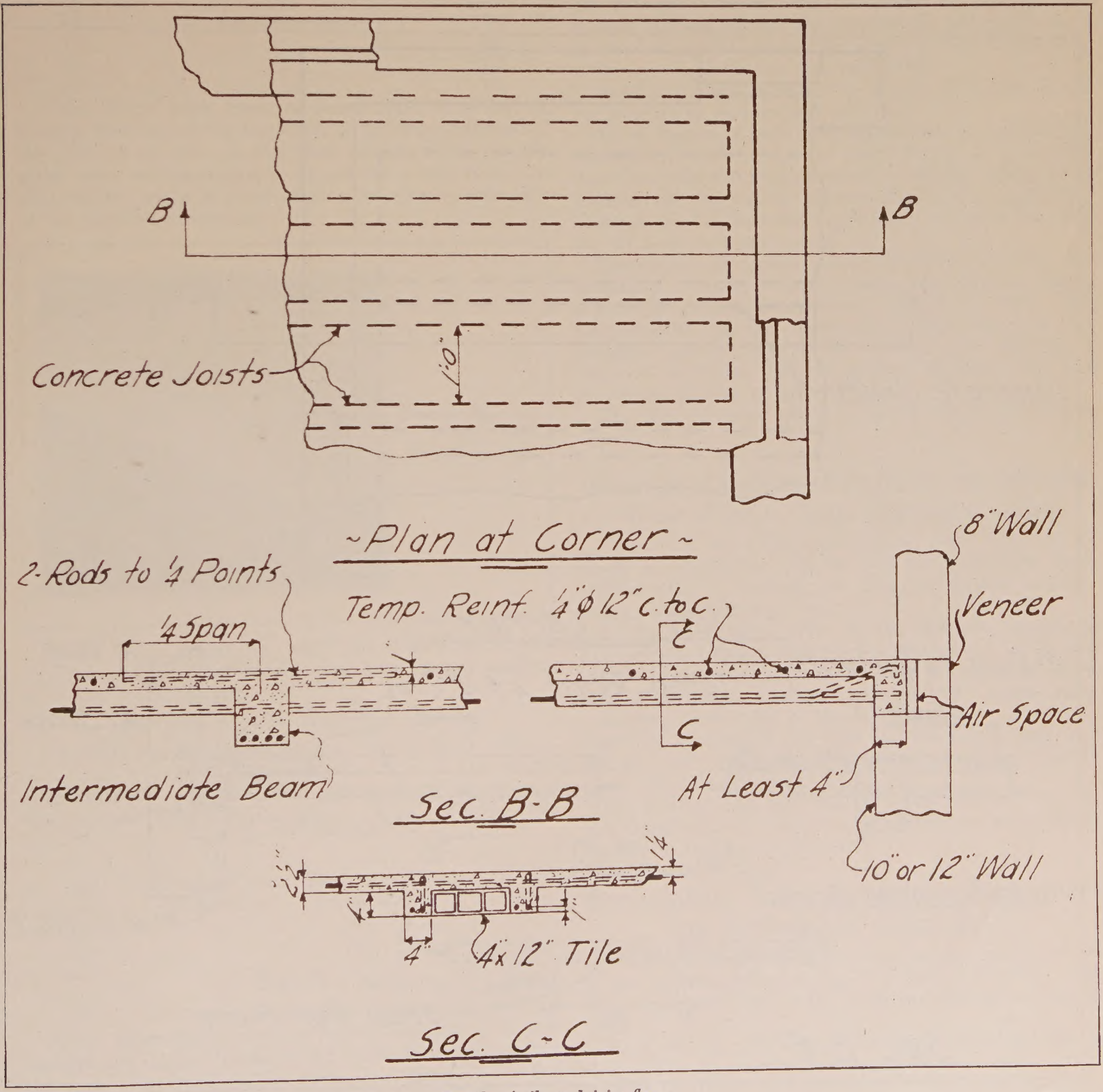
Table 6 presents the necessary information relative to the span and aggregate used for the tile and joist system of floor construction. In this type, tile is placed upon planks laid flat and supported by posts below. Sufficient space is left between the tile to form beams of the required width. The reinforcement is laid between the tile and pipes and conduits can also be placed in this space. Many concrete products manufacturers are finding an attractive market for concrete tile and block for this type of concrete floor construction.

Table 7 refers to the arch and joist system of concrete floor construction in which steel or wooden pans take the place of the tile. The pans are removed and used over and over again. This type of construction is lighter than the tile and joist system.

Economical Systems

The last two systems mentioned are more economical in material than the slab type, but they are also more difficult to construct.

In the designs that follow, no attempt was made to design the intermediate beams to which the slabs or joists run from the walls. The sizes of these beams depend upon the locations of the partitions and on the loads placed upon them from the floors above. The designing stresses used were 18,000 pounds per square inch for steel and 800 pounds per square inch for concrete, as allowed in the building code of the District of Columbia. This code was also followed in regard to the minimum thicknesses of slabs and widths of joists.



Details of tile and joist floors

TABLE 1.—Pumice—94 Lbs. Per Cu. Ft.

Solid Slab Floors

Span in Feet	Thickness of Slab, Inches	Dia. of Round Reinforcing Bars	Spacing of Bars in Inches
10	3	3/8	6½
11	3½	3/8	6½
12	3½	3/8	5½
13	4	3/8	5
14	4	½	8
15	4½	½	7½
16	4½	½	6½

TABLE 2.—Coke—100 Lbs. Per Cu. Ft.

Span in Feet	Thickness of Slab, Inches	Dia. of Round Reinforcing Bars	Spacing of Bars in Inches
10	3	3/8	6½
11	3½	3/8	6
12	3½	3/8	5
13	4	3/8	5
14	4	½	7½
15	4½	½	7
16	4½	½	6½

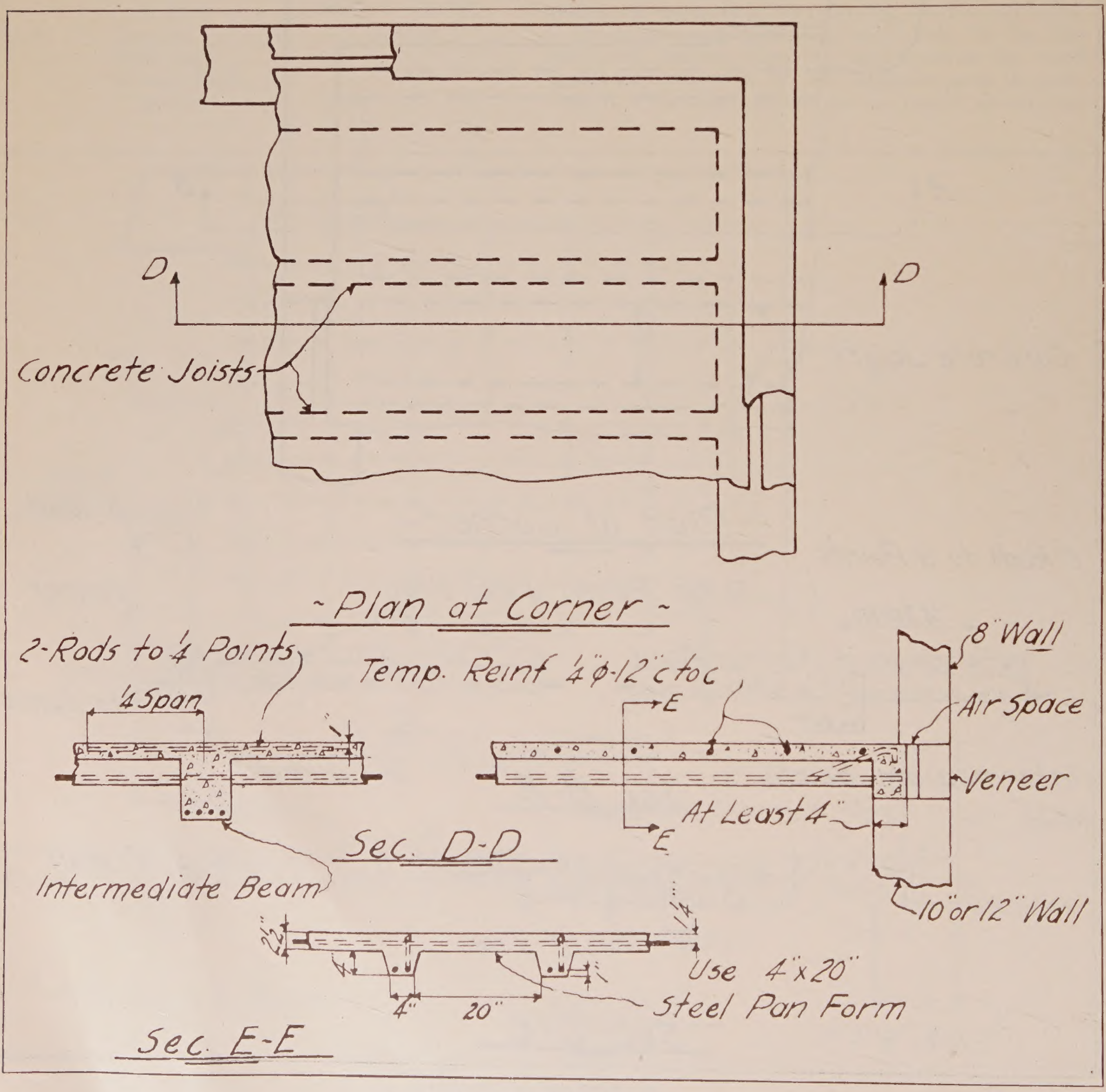
TABLE 3.—Burnt Clay—106 Lbs. Per. Cu. Ft.

Solid Slab Floors

Span in Feet	Thickness of Slab, Inches	Dia. of Round Reinforcing Bars	Spacing of Bars in Inches
10	3	3/8	6
11	3½	3/8	6
12	4	3/8	6
13	4	3/8	5
14	4½	½	8
15	4½	½	7
16	5	½	7

TABLE 4.—Cinders & Crushed Brick—117 Lbs. Per Cu. Ft.

Span in Feet	Thickness of Slab, Inches	Dia. of Round Reinforcing Bars	Spacing of Bars in Inches
10	3	3/8	6
11	3½	3/8	5½
12	4	3/8	5½
13	4	3/8	4½
14	4½	½	7½
15	4½	½	6½
16	5	½	6½



Details of arch and joist concrete floors

TABLE 5.—Slag—130 Lbs. Per. Cu. Ft.
Solid Slab Floors

Span in Feet	Thickness of Slab, Inches	Dia. of Round Reinforcing Bars	Spacing of Bars in Inches
10	3½	⅜	6½
11	3½	⅜	5½
12	4	⅜	5
13	4	½	7½
14	4½	½	7
15	4½	½	6
16	5	½	6

TILE AND JOIST CONCRETE FLOORS
TABLE 6.—Reinforcement for Various Spans and Aggregates

	Aggregate	
Span in Feet	2⅜ In. Rods	2½ In. Rods
10	All	--------
11	All	--------
12	All	--------
13	All Except Slag	Slag
14	--------	All
15	--------	All
16	--------	All

Note: Where joists frame to beams rods are to be run straight and lapped for the width of the beam supporting the joist. Two rods of the same size specified for the given span and aggregate to be placed 1 inch from top slab and to run to ¼ point of the joist span to take care of the negative movement.

Concrete floor cast as a unit with foundation wall

Where joists frame into wall one rod is to be run straight, and the other rod is to be bent up and hooked, as shown in the details.

ARCH AND JOIST CONCRETE FLOORS
TABLE 7.—Reinforcement for Various Spans and Aggregates

	Aggregate		
Span in Feet	2⅜ In. Rods	2½ In. Rods	2⅝ In. Rods
10	All	--------	--------
11	All	--------	--------
12	Pumice, Coke, Burnt Clay	Cinders or Cr. Brick, Slag	--------
13	--------	All	--------
14	--------	All	--------
15	--------	All	--------
16		Pumice, Coke	B. Clay, Cinders or Cr. Brick, Slag

Note: Where joists frame to beams, rods are to be run straight and lapped for the width of the beam supporting the joist. Two rods of the same size specified for the given span and aggregate to be placed one inch from top of slab and to run to ¼ point of the joist span to take care of the negative moment.

Where joists frame into wall one rod is to be run straight, and the other rod is to be bent up and hooked, as shown in the details.

October Building Decreases but Remains Highest for That Month

Construction operations, facing the advance of colder weather, decreased in volume during October, according to statistics compiled by the Associated General Contractors of America. The drop was not great enough, however, to deprive 1927 of its chance to set a new record for construction activities. The total volume for the first ten months of this year is five per cent greater than the figure registered for the corresponding period of 1926.

The October volume was eleven per cent smaller than the September mark. But the plane of activity three months ago was so high that, despite the perceptible drop in October, a total greater than any ever before registered in the month of October was established.

In no year since 1921 has the month of October shown an increase in construction activities.

These figures, based upon shipments of construction materials, cover all types of construction. It is reported that residential building has shown a decline during recent months, but the volume of commercial and engineering construction has increased sufficiently to raise the total for all types to a new record.

The volume of contracts awarded during the first nine months of this year is appreciably greater than the figure registered in the corresponding period of 1926. This fact, coupled with the comparatively high degree of construction activity noted at the conclusion of October is taken as indicating that the opening of winter will find operations moving at a lively pace.

The cost of construction remained unchanged during October.

Former Civilian Engineer on Middle West Public Improvements Dies

Gustave A. M. Liljencrantz, whose death occurred recently at Stockholm, Sweden, was for forty-seven years civilian assistant engineer on river and harbor improvements for the Chicago district.

In the conference room of the Western Society of Engineers at Chicago hangs the original sketch of the seal of the organization, drawn by Mr. Liljencrantz at the time of the society's incorporation in 1880. Beside being a charter life member of the Western Society, he was an honorary member of the Chicago Engineers Club and affiliated with the Swedish Engineers Society and Scandinavian Engineers Society.

Mr. Liljencrantz, who was 85 years old, and the son of a Swedish baron, retired in 1916, returning to his native country to resume his baronetcy.

Association Joins American Engineering Standards Committee

The Portland Cement Association has become a member of the American Engineering Standards Committee, with direct representation on the Main and Executive Committees.

F. W. Kelley, president of the North American Cement Corporation, represents the association as a member of the A. E. S. C. executive committee.

Cast Stone Tests Show High Strength

Some Interesting Strength Tests on Facing and Backing Mixes Used for Cast Stone Manufacture

By F. R. ZAUGG

THAT exceedingly strong concrete is obtained in the manufacture of cast stone was recently shown by a number of test cylinders made at the plant of the Pacific Stone Co., 4257 Eighth Avenue, N. W., Seattle, Wash.

An average of 7500 pounds per square inch crushing strength was obtained on a set of three cylinders made from the regular backing mix for the cast stone. An average of 6500 pounds and 9250 pounds per square inch was obtained for the two different types of facing materials.

The material for making the cylinders was taken from a regular batch and without any advance information to the workman that the test was being made. Each cylinder was made as near to shop practice as possible and cured along with the regular run of cast stone.

The procedure followed was briefly thus: A 3- by 6-inch brass cylinder was partially filled with the material and rammed with the regular cast stone air hammer the equivalent number of blows that the regular stone receives, the cylinders requiring three applications of the loose material to be completely filled. The form was immediately removed and the cylinders thus made were allowed to receive their initial set in the open air. They then were placed in the steam curing room under a temperature of approximately 125 degrees F. for 10 days. The balance of the time to 28 days, the cylinders received the ordinary air curing.

Three cylinders were made from the backing aggregate, a 1:2:3 mix, with approximately 3½ gallons of water per sack of cement. The maximum size aggregate was approximately ¼-inch. Three cylinders each from two different sets of facing materials that were being used at the time, were also made in the same manner.

After the 28 day period of curing, the cylinders were broken at the Structural Materials Laboratory of the University of Washington, under the direction of Prof. Ira L. Collier. The tabulated results were as follows:

	No.	Cylinders crushed at (lbs.)	Pounds per square inch
Backing Mix	1	62,270	8,810
1:2:3	2	42,920	6,070
	3	54,720	7,740
		Aver.	7,540
Facing Mix	1	48,980	6,920
No. 94	2	45,320	6,410
1:2½	3	43,860	6,210
		Aver.	6,513
Facing Mix	1	59,040	8,350
No. 93	2	69,750	9,870
1:2½	3	67,480	9,530
		Aver.	9,250

The wide difference in crushing strength between the two facing materials was due to the fact that No. 93 facing was red aggregate of high structural strength, No. 94 being a pinkish aggregate of much softer composition.

The results indicate that the cast stone as made by the Pacific Stone Co. is of very high quality both as to material and workmanship. Two 8-story buildings in Seattle have recently been faced with the product from this plant along with many other smaller jobs. The cast stone industry in the Northwest is enjoying an increasing demand, due largely to this high quality.

Materials Exposition to Be Part of A. G. C. Convention

A national construction exposition will be part of the annual convention of Associated General Contractors of America at West Baden Springs, Indiana, on January 23rd to 27th. All types of construction materials, supplies and accessories for industrial, engineering, governmental, transportation, and specialty building projects will be included.

Exhibits will be prepared by many of the leading construction materials and supplies companies of the country, it is announced. First, second and third awards will be made by the Associated General Contractors of America, through a special committee, to the companies having displays adjudged the most effective.

The exposition will be held in the large circular, skylighted, "Atrium," itself a construction novelty, of the West Baden Springs Hotel. Association sponsorship and control of the exposition and the unique arrangement of convention, exposition and guest facilities at West Baden, the announcement points out, will combine to give the exposition a unique character.

The show will open officially at 9:30 a. m. daily. Official evening closing hours will vary in accordance with the entertainment program of the association.

The general office of the exposition is at 225 West 34th Street, New York City.

The convention with which the exposition will concur will be the ninth annual meeting of the contractors' national organization and will be attended by delegates from virtually every state.

Leeds Building Artificial Stone-Faced Houses

Whether the artificial stone-faced houses now being constructed in Leeds, England, will become popular only time will reveal, but sundry erections of detached and semi-detached residences are always in progress. The type of synthetic stone-work favored is made from a mixture composed chiefly of sand and cement. After preparation the mass is placed into steel moulds of a certain scheduled size, and when the hardening process is complete the whole block is turned out and utilized in the same manner as ordinary stone. Most of these blocks are made to imitate rough-faced masonry, and look very effective after construction. It is claimed that dwellings constructed of this material are less absorbent of water and offer more resistance to frost than the best quality building stone. Construction costs work out as with the ordinary brick house.

EDITORIALS

Check-Up Time

NOW, as the short, cold days set in and business activities slow down somewhat in spite of the growing tendency to lengthen the outdoor construction season, is a good time to sit down and check up. The end of the year, too, is approaching when most men consider one cycle of activity completed and another beginning.

It is good sometimes to stop a bit between periods to review the experiences of the past year and glean from them the lessons that will make the coming year more prosperous and more satisfying.

As you look back over the work done during the past season, there are some details of equipment performance or routing of materials that you found to be not quite as good as they ought to be. Now is the time to correct these faults. Most of us do not study our plant layouts carefully enough. Often a short time devoted to this problem will suggest a means of cutting down the distances that aggregates must travel from the cars to the bins or from the bins to the mixer. Perhaps a relatively slight rearrangement of equipment or a new piece of equipment to replace some old machinery that has been giving trouble, will mean a decided reduction in the cost of the concrete in the mold. The slack season is the best time to improve this condition. When work is under way full tilt again, that job will be postponed again till next winter.

It will be a profitable effort to make such an analysis of every detail of your plant and methods of operation. Then consider your relations with the men you do business with. Perhaps there is room for progress there, too. After a job is lost it is usually possible to see the reason for losing it. Study these lost jobs and profit by them.

So you will be looking forward confidently to 1928, better equipped to do a better job than ever before.

Your Conventions

NOW comes the season of the year when conventions are the order of the day. Are you planning to attend the conventions that you are particularly interested in?

During the coming months a number of national conventions are scheduled, embracing the entire field of concrete construction. Besides these there are the local or state conventions. Attend them and take part in them!

There is much of benefit and inspiration to be found in these get-togethers where other men facing the same problems that you are facing come. The helps received from the papers and discussions on the program are not all the advantages that attendance brings. It is good to meet and to rub elbows with the other men in your industry.

Make Your Concrete Dense

SO much has been said about the permanence of concrete that we are sometimes apt to forget that it is only dense concrete which has a reasonable claim to be considered truly permanent. And right now when concrete is under fire from so many different quarters it is well for the individual concretor to remember that if his work is to have the permanence which all concrete deserves it must be made as dense as the working limits of the job permit.

It has been quite generally claimed for some time that the most permanent concrete is that which is watertight to the greatest degree. Not all concrete work is done under conditions which permit the greatest density, and neither is all concrete of such a nature that it is necessary for it to possess the quality of permanence. But it is ordinarily true that concrete is usually used where greater permanence is desired than is provided by other building materials. It is likewise a good rule that all concrete, wherever placed, should be just as dense as conditions permit.

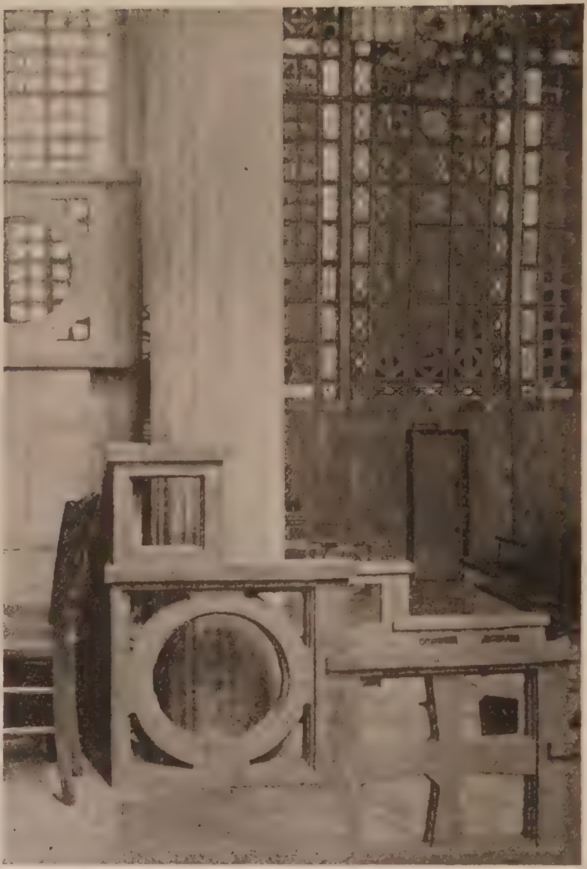
There is another angle to this question of density which ought not be entirely overlooked. Most concrete construction is so designed at present as to allow for the use of concrete which is considerably less than perfect, and which is not particularly uniform in strength. Just as soon, however, as it is safe for designers to assume that the average contractor is going to place concrete which will be free from voids and honeycombing, which will be reasonably impermeable, and which will be reasonably uniform in strength, a less heavier type of design will be practicable, with resulting economies to both builder and contractor. A more uniformly dense concrete is, of course, an important aid to this end.

We offer no particular recipe for dense concrete. Nearly every man who uses concrete knows one way or another to obtain it. Careful grading of aggregates, the use of proper amounts of mixing water, generosity in the use of cement, and under certain conditions the judicious use of admixtures — all these things singly or together help to secure the sort of concrete which the cement companies talk about—"Concrete for Permanence." And it is only such concrete that the concretor is going to be proud of having placed after it has been exposed to the elements for ten or fifteen years.

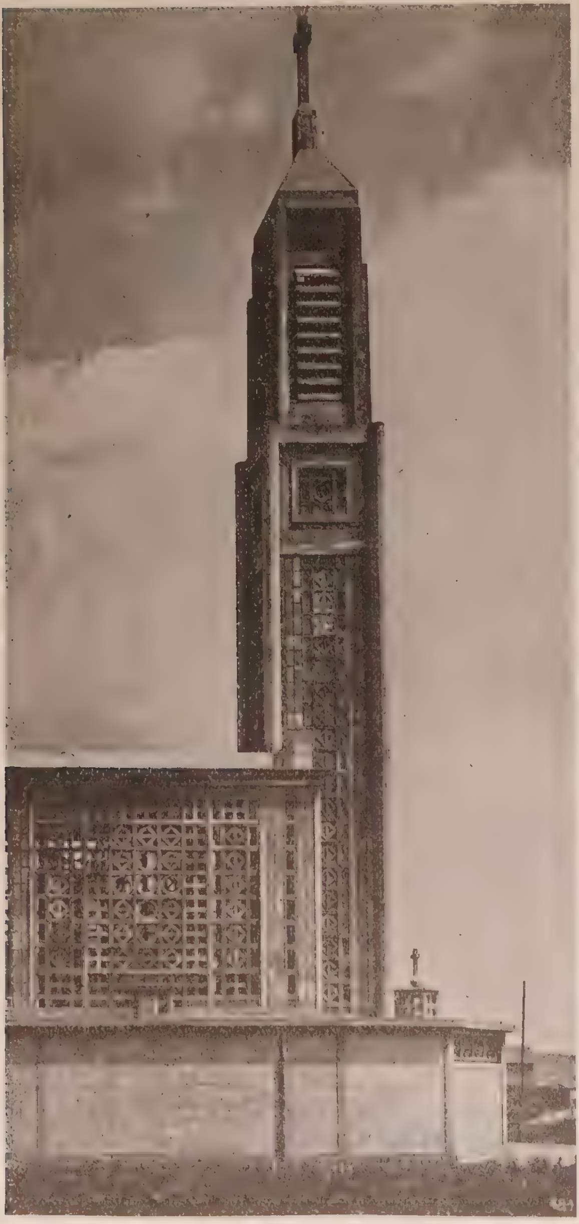
If you would have your jobs fit objects of pride ten years hence, see to it that your concrete is dense.

CONCRETE IN ARCHITECTURE

Two Reinforced Concrete Churches in France, Designed by A. and G. Perret, Architects



Interior of church at Le Raincy, near Paris, France

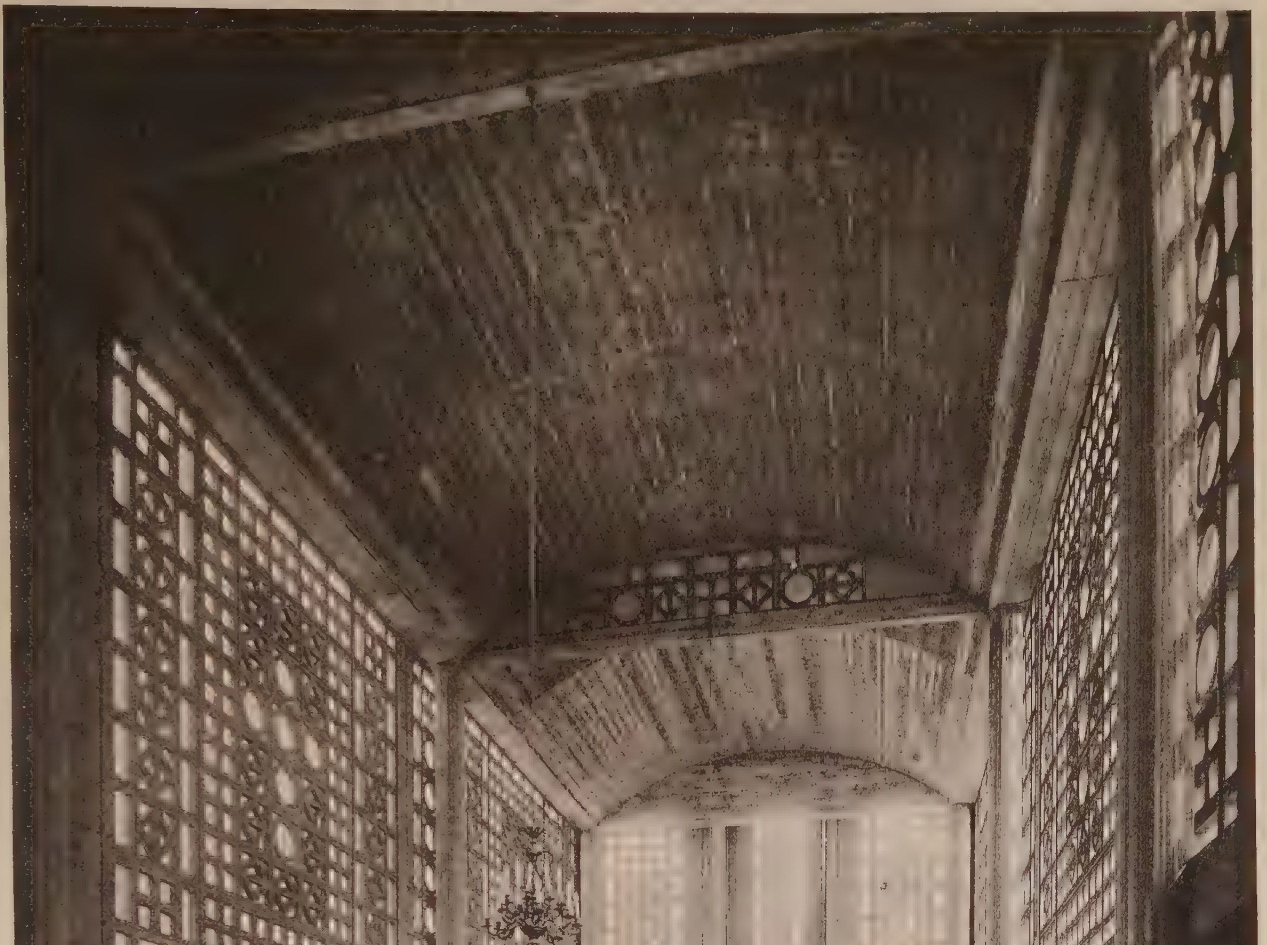


Church of St. Theresa, Montmagny, France

"The church at Le Raincy is one of the most remarkable examples of concrete tracery so far developed," says Dr. F. S. Onderdonk in the September "Western Architect," this issue being entirely devoted to the uses of concrete in architecture.

"The recently completed St. Theresa church introduces a new epoch, as the entire wall surface consists of concrete tracery. As can be seen in the illustration, the concrete columns are placed inside, behind the tracery walls so that the exterior walls appear like an uninterrupted 'frozen' lace curtain. . . . . The glass area of the walls is so large that the church as a whole has the effect of a great lantern.

"As you turn your back on St. Theresa to return to Paris, a magnetic power seems to force your eyes once more in the direction of the edifice. The church, a glowing, concrete-lace lantern, predicts great things to come: a colorful, brilliant, impressive architecture. Shall we call it the Concrete Style?"



Interior, looking toward the altar, Church of St. Theresa, Montmagny, France.
A. and G. Perret, architects

Nine Acres of Quality Concrete in New Michigan Stadium

15,000 Cubic Yards of Quality Controlled Concrete Placed in Recently Completed University of Michigan Stadium at Ann Arbor—Construction Methods Used—A Rush Job That Was Completed Ahead of Schedule

FOOTBALL fans who watched the Michigan team play its games at Ann Arbor this fall sat in a new concrete stadium in the construction of which there were several features of particular interest to concretors. The contract called for the completion of the stadium by October 1st, and the last concrete on the job was placed in the forms on the second of September. Concrete quality was carefully controlled with the result that average test results show approximately the following results:

Days	Lbs. per square inch
4	1900
7	2750
28	4700

An efficient method of placing the concrete was employed by the contractors, the James Leck Company of Minneapolis, who used a similar method when building the Minnesota stadium.

The Osborn Engineering Company of Cleveland, specialists in stadium design and construction, acted as engineers for the project.

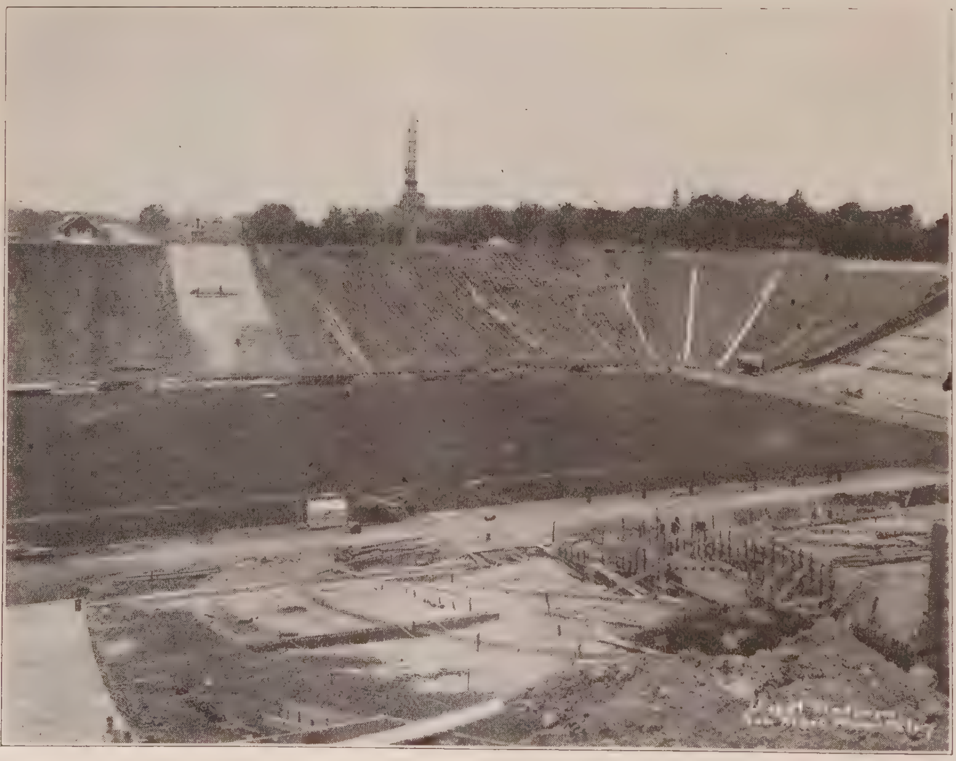
A feature of interest is the fact that Michigan won the dedication game in its new stadium—an unusual occurrence.

General Features

The seating capacity of the stadium proper is approximately 72,000 persons. By erecting temporary auxiliary seats 86,000 people have been accommodated three times this year. The distance from the topmost row of seats to the playing field is 49 feet. There are 68 rows of permanent seats and 4 rows of box chairs.

The stadium is built on a side hill, being partly on excavated ground and partly on filled ground. On the west side, the finished grade of the land is at the same elevation as the concourse above the seats. The concourse at the north and south ends is also at the level of the ground. The east side concourse is about 17 feet above grade. Here the team rooms are located under the main stairway entrance. A tunnel leads from the team rooms to the playing field. Spectators enter the stadium through 13 portal entrances at the east side while entrances from the ends and the west side are made directly from the concourse at the top of the rows of seats.

The concourse extends around the top of the entire structure, a distance of about half a mile, and consists of a concrete slab 27 feet wide. The entire structure is enclosed by a parapet wall. Above the concourse on the



o—O—o

A general view of construction operations on the new University of Michigan stadium

In the background is the mixing plant from which the concrete was chuted into place

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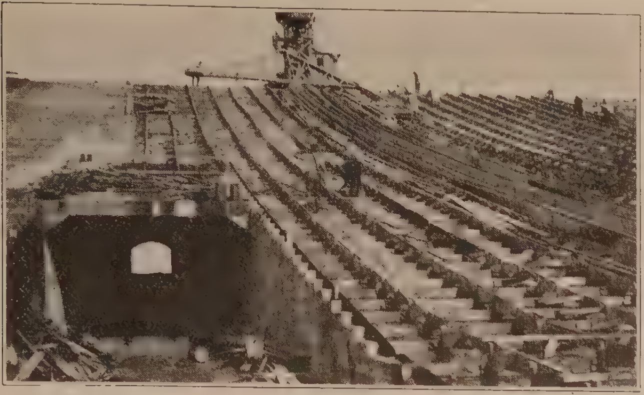
west side is a press stand equipped with three broadcasting booths, telephones, telegraph equipment, etc.

The stadium is so designed that an upper deck can be added later if desired.

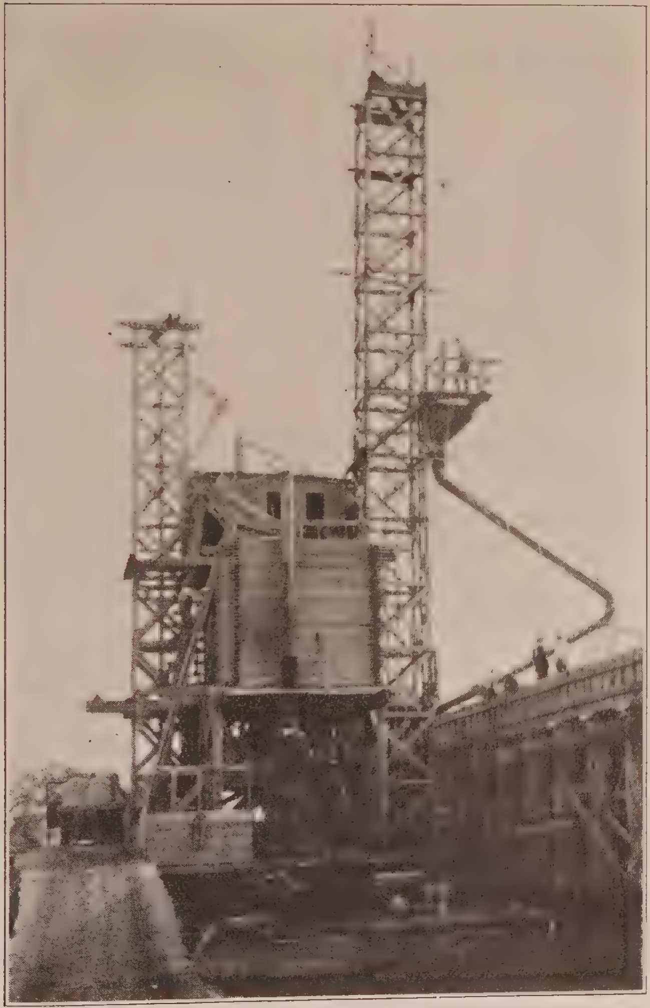


The tunnel leading from the athletic rooms to the arena

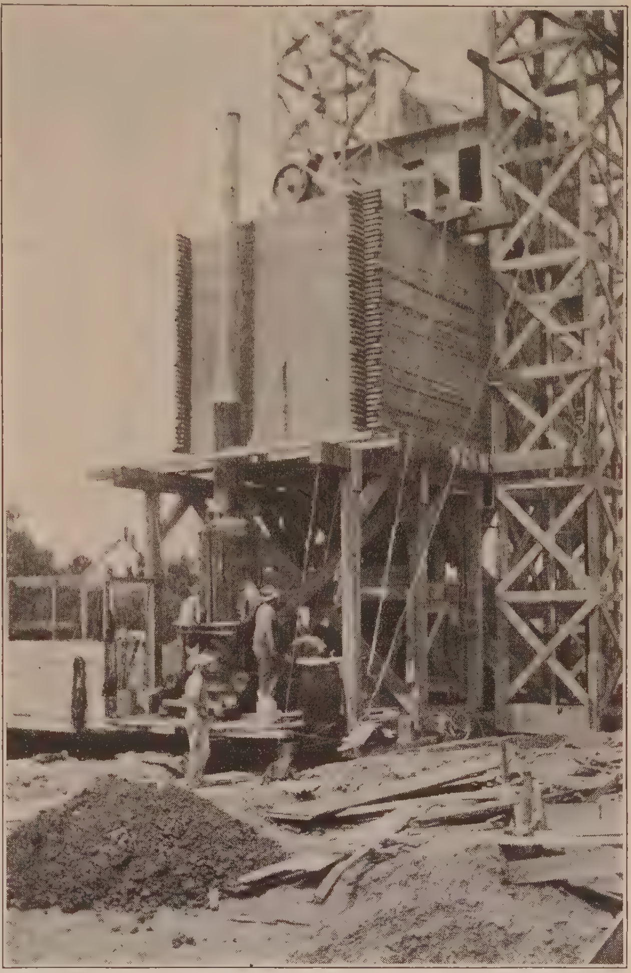
Design

Wherever the stadium rests on excavated ground, the slabs rest directly on a 6-inch layer of cinders placed directly on the soil foundation. On fills the slab is supported on a structural frame of reinforced concrete columns and beams.

The stadium is divided radially into 44 sections. Each of these sections is divided into 3 units to provide for vertical expansion and contraction. Anchor walls for each unit, cast monolithic with the slabs, are built half way up the slope.

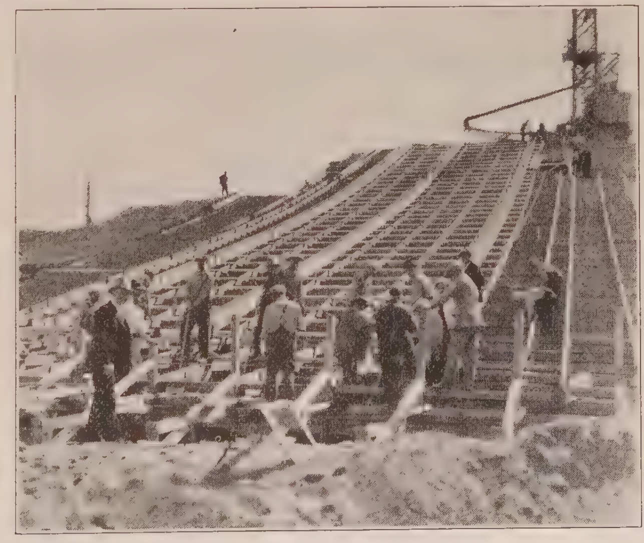


The movable central mixing plant. Aggregates were received into a pit below the incline on the left and lifted by a bucket conveyor to the bins. Concrete was chuted from the tower at the right. The entire mixing plant was movable



Another view of the mixing plant showing the arrangement of the mixing and hoisting equipment

Vertical joints dividing the 44 sections are of copper. They consist of copper troughs with flanges extending into the concrete on both sides.



From the tower the concrete was chuted into troughs which delivered it to the forms. Concreting was begun at the lower end of the slope and the troughs were shortened as the work progressed upward

The specifications called for concrete having a compressive strength of 2500 pounds per square inch at 28 days. Not more than 7 gallons of water were to be used for each sack of cement and the slump was not to exceed 6 inches.

Washed sand and washed gravel were used as aggregates. Proportions ranged from 1:1:1¾ to 1:2:3½, a field mix of 1:2.2:2.8 being generally used after adjustments for bulking of the aggregates were made. It was found that this mix, with a 5-inch slump, provided sufficient plasticity to permit chuting the concrete.

Drainage Provisions

At the bottom of the seats, extending entirely around the arena, is a 3- by 4-ft. drainage gallery which discharges into a 48-inch pipe that leads the water away.

Leading into the drainage gallery are 6-inch tile which are fed by lines of 4-inch tile placed horizontally at intervals of 20 feet under the seat slabs.

The field is drained by tile lines which cross the field diagonally every 20 feet. These also discharge into the drainage gallery.

Placing Concrete

The fact that the contractors were not permitted to use the playing field area made it necessary to place the concrete from the outside rim of the stadium. The method adopted was to construct a portable mixing plant which was placed at the top of the stadium and moved around the circumference as the seat slabs were cast. The concrete was chuted into place direct from the mixer. The concrete for the seat slabs and the concourse of each unit was placed in one operation from each location of the mixer.

Seat form details

The mixing plant consisted of bins for sand, gravel, and cement, a ¾-yard Knickerbocker mixer, proportioning devices and a hoist and tower. All this was assembled on a movable platform placed on 7-inch rollers. A cable and hoist were used to move the mixing plant from section to section as the concrete was placed. It was possible to chute the concrete into place on two sections from each set-up.

The bins at the mixing plant provided storage capacity for 30 cubic yards of sand and 50 cubic yards of gravel. Aggregates were delivered to the job in trucks, dumped into a hopper and lifted by a bucket elevator into the bins. The hopper and elevator were a part of the movable equipment.

The bins discharged into a measuring box for the gravel and into a Blaw-Knox inundator for sand where the materials were proportioned. As the concrete left the mixer, it was hoisted to the top of a 66-foot tower and then chuted to troughs laid on the forms as shown in the illustrations.

The concrete was mixed for a period of 1½ minutes. The average time required for charging the mixer was about 12 seconds. The 5 bags of cement for each batch were placed into the hopper with the aggregate and all the materials were dumped into the mixer at the same time. This detail helped to speed up the work.

The concrete was placed first at the bottom of the seat slab. As the work progressed and the concrete reached up higher on the slope, sections of the troughs were taken up. This method permitted the placing of the concrete with a minimum effort. Usually it was possible to concrete an entire section—about 200 cubic yards—in a day's run. A day was required to move the plant from one location to the next.

An exceptionally satisfactory curing method was adopted. A row of sprinklers was placed at the top of the slab which kept a film of water flowing over the entire concrete slab from 7 A. M. to 7 P. M. for 14 days after the concrete was placed.

Though the job was scheduled for completion on October 1st, the last concrete was placed two weeks ahead of schedule and the stadium was ready to serve the football enthusiasts as anticipated.

The work was done for the Board of Control of Athletics of the University of Michigan. Fielding H. Yost, Director of Athletics, had direct charge of the project.

D. S. M. Leck, vice-president of the James Leck Company, was in charge for the contractor and N. A. Mortenson was the superintendent of construction. C. J. McCorkle represented the Osborn Engineering Company.

1928 A. C. I. Sessions to Open in Mid-Day

An informal noon-time luncheon will launch the 24th annual convention of the American Concrete Institute at the Benjamin Franklin Hotel, Philadelphia, Pennsylvania, on Tuesday, February 28th. The first regular session will begin at 2 o'clock with papers on notable work of general interest.

The second session of the day will be at 8 o'clock, when six short papers dealing only with workability will be presented, with ample time for discussion.

A morning session on materials and research, including a paper on an investigation of crazing, one on waterproofing tests and two others unannounced as yet, will be held Wednesday, February 29th, the second day.

The fourth session, on the afternoon of the 29th, will be devoted to cast stone and special factory made products. The evening's session following, on reinforced concrete design, is to include a paper on skew arch design by S. C. Hollister, one on the revised building regulations, by Committee E-1, and another by Arthur R. Lord discussing the effect on economic and engineering progress of the design of high early strength concrete, supplemented by numerous design tabulations and charts, and another paper as yet unannounced. This program is planned to be of general interest and conducive to discussion.

At the seventh session will be presented a paper by Chas. Covell on a new, economical, hard-wear floor surface, one by R. C. Johnson on experiences in executing a big building contract taken on a strength basis, and two other unannounced papers.

A dinner in the evening, with a brief address by the president, the award of the Leonard C. Wason medal for the most meritorious paper of 1927, the award of the new Henry C. Turner medal for "notable achievement in the concrete industry," and an unannounced address, will close the 1928 sessions.

A Light, Auxiliary Derrick Equipped With Special Set of Fittings

WHERE it is desired to rig a light derrick on the concrete hoist tower for the purpose of pulling up forms, hoisting reinforcing steel and miscellaneous heavy ironwork, such as cast iron door saddles, channel doorbucks, etc., it has been found that the ordinary fittings frequently cause trouble where heavy loads are being handled. Such fittings are mounted on one of the corner posts of the hoist tower, and transmit to it heavy twisting stresses, which tend to loosen the bracing and weaken the tower. When made by the job blacksmith a poor fit often results. The pin will work out of plumb and bind, proper lubrication is difficult, and because of the variable quality of the blacksmith work the parts are occasionally subject to flaws in the metal.

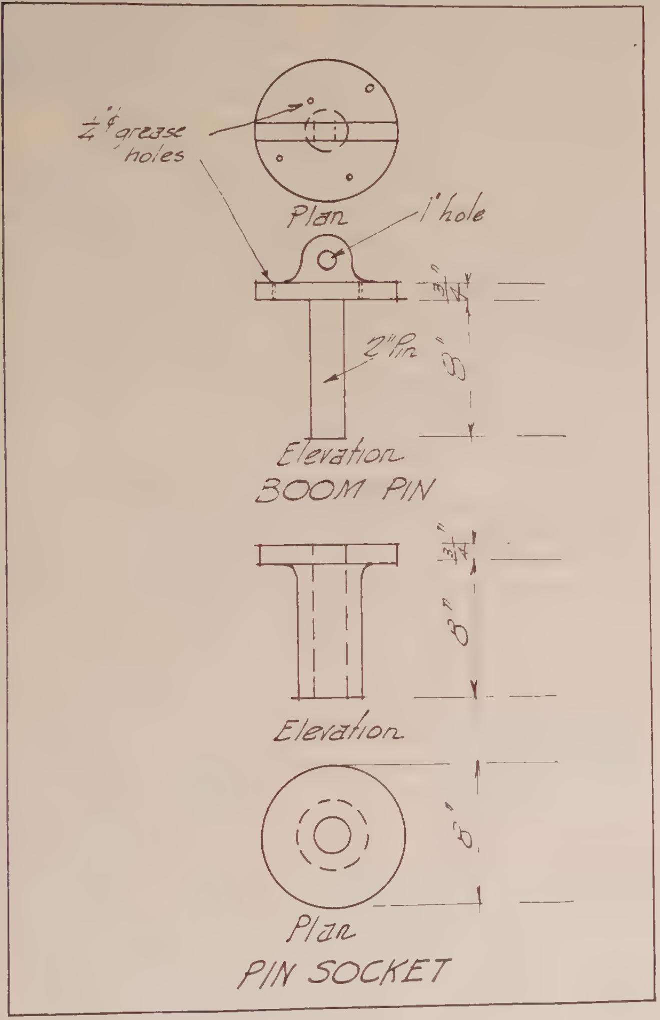


Figure 1

To overcome these objections one construction superintendent had a special set of fittings made at his own expense and took them from job to job with him. These fittings, which gave excellent results, even with heavy loads and long use, are shown in Figure 1. A piece of 6-inch shafting was turned down and bored to form a tube with a flange at one end. A second piece of shafting of the same size was turned down to form a pin which would just slip easily into the tube. A wide flange was left on the pin, and above the flange the shaft was cut to form a heavy lug, which was drilled to take the pin or bolt in the irons on the lower end of the boom, usually a 4x4-inch or 6x6-inch shoring timber.

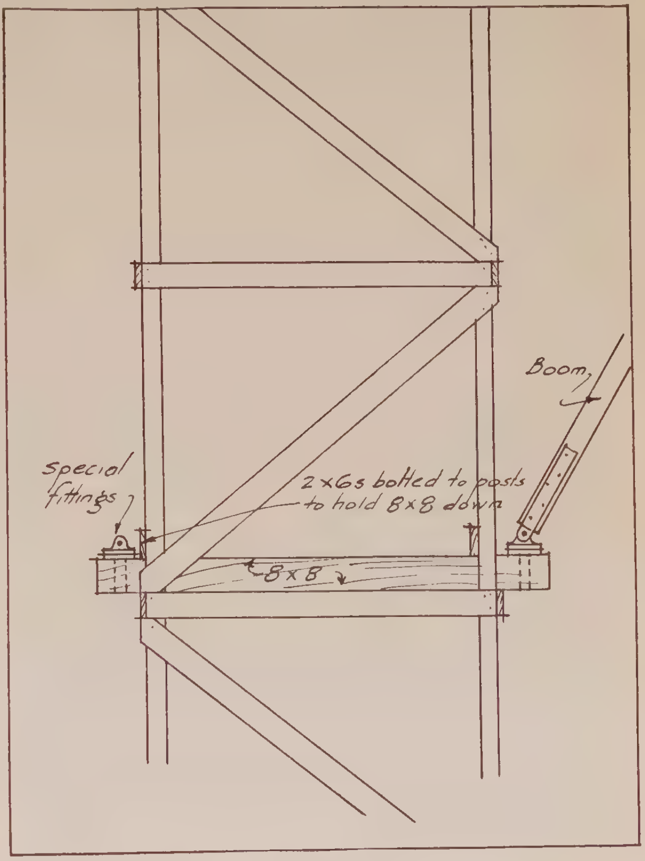


Figure 2

A pair of irons were fitted to the lower end of the boom, and the whole assembled in place on the hoist tower. Figure 2 indicates the method. An 8x8-inch timber was laid across the horizontal bracing of the tower and made fast. Holes drilled in outboard ends of the timber took the socket irons, in which the pin and boom were stepped. Lubrication was taken care of by means of holes drilled in the pin-flange, and by a spiral groove cut around the pin. In the event of the pin seizing, any twisting strain was transmitted through the 8x8 to the whole tower, and not concentrated on one corner post.

"Concrete" will pay from $2 to $5 for every kink accepted for this page. What is yours? Send it in.

Here and There

Some Random Notes on Visits with Concretors in the Field

CHRISTMAS is not far away. Have you determined how you are going to send your customers greetings? Most men like to be remembered and it is a simple thing to send them your best wishes in a form letter or a card. Business need not always be the hard, impersonal struggle to make a living and a little touch of personal friendship, especially at Christmas time, makes business relations more pleasant.

◆

AND wish him a happy, prosperous New Year, too. Remember that you as a products manufacturer, prosper in direct proportion as the contractors or other users of your products prosper. When you work for their welfare you are indirectly working for your own.

◆

THERE is an interesting development going on in the clay brick plants in one section of the East. Several such plants have entered the concrete products business. They are crushing their culled brick and using the material as aggregate for concrete block and brick. Then, too, they are using the cinders that result from burning the brick and use them as aggregate for concrete block.

◆

ANOTHER merchandising idea is the use of a special laboratory service for the purpose of building up confidence in the blocks manufactured by a products man who appreciates the value of aggressive selling. He has made an arrangement with the commercial testing laboratory that is best known among builders and architects in his sales area under which a representative of the laboratory selects five blocks each week and gives them the standard tests.

Once every four weeks the block to be tested are taken from the factory and sealed just as they come from the machine. The other three weeks the block are taken from any one of the jobs on which they are being used.

The reports of these tests are kept in the files of the testing laboratory and the laboratory will provide any building contractor, architect or inspector with the test data on any job that he is interested in. The results of these tests and the manufacturer's evident confidence in the quality of his block furnish excellent copy for advertisements in newspapers and for direct mail literature.

◆

ONE concrete products manufacturer made a dandy design of a wall drinking fountain which he cast in concrete. He has sold quite a number of them for use in the lobbies of moving picture theaters and for side wall flower pots in various types of buildings. He keeps a number of them in stock instead of making them up as they are needed.

AS you go around visiting concrete products plants, you are surprised to see that almost all of them have at one time or another thought of making concrete tomb stones. There are a wide variety of designs found in the various plants. One products man has adopted three standard designs that are easy to make. He never pushed them at all and yet he sells quite a few. He has them standing in the yard near the burial vaults. When people come to buy a burial vault, they get interested in the tomb stones.

He sells these tomb stones for $30.00. They cost him $12.00 to make and a similar stone in granite or marble would cost around $80.00.

◆

A MOST unusual method of attracting interest to a building material has come to our attention. In order to get the attention of architects, this manufacturer has made practical use of a hobby. For years he had been raising homing pigeons and they are now his attention getters. He sends one pigeon in a cage to a prospect or to an architect and asks to set the pigeon free and to return the cage. An arrangement has been made with the post office department whereby he guarantees return postage on the cage. A return tag is attached when the prospect receives it.

In the cage is a note which is to be placed in the little cartridge attached to the pigeon's leg. The note simply state that the undersigned is interested in the building materials the sender manufactures and would like additional information. A place is provided for the prospect's signature. Who wouldn't sign that message and release the pigeon to carry the message back to the sender?

Usually the entire staff of the office to which the pigeon is sent gathers around and asks questions. In several years use of this method of calling attention to his products, only one person has refused to sign the return note.

◆

WHILE visiting one of the cleanest concrete products plants we ever saw, we noticed that in one room there were a lot of dandy looking concrete mantels. They were made in various designs, some imitating stone and some brick. Not only was the decorative front of the fireplace made in cast stone, but the fire-box back of the opening was made in a solid concrete cast. Most of the mantels are used in apartments for gas logs or for electric heaters and the concrete back or fire-box has worked out satisfactorily when it is lined with asbestos sheeting between the fire-box and the wall.

The cost of these fireplaces is in most cases less than brick and quite a business has been developed in their manufacture and sale.

◆

A MERRY Christmas and a Happy New Year to you!

How to Make Concrete Floor Tile

An Attractive Opportunity—Market is Practically Undeveloped in Most Localities—Methods of Making Concrete Floor Tile — Color — Tile Designs — Equipment Needed—Laying the Tile—Costs—Merchandising

THE steadily growing appreciation of the value of clean, sanitary, fire resisting floors for homes, offices, stores, etc., coupled with progress made in the use of color in concrete products makes this an opportune time for the products manufacturer to consider adding concrete floor tile to his line. In some sections of the country concrete floor tile of good quality are made and used in quantities sufficient to insure this as a profitable manufacturing venture. Though the market is now supplied in a few localities most communities are not now being supplied with this concrete products specialty. In fact, only a relatively few architects and builders know of the possibilities of concrete floor tile.

This condition is probably, in a measure at least, due to the scarcity of definite information available on manufacturing problems. Most floor tile manufacturers consider their methods more or less secret and the products man who would like to make floor tile may be deterred because of his unfamiliarity with this field.

The manufacture of concrete floor tile is not an easy process, though satisfactory tile can be made if sufficient care is exercised. The products man undertaking the manufacture of this specialty must make up his mind to experiment to some degree before he perfects his process. He must also be determined to exercise care so that a good quality of tile will be produced. This is one field in the concrete products industry that has not yet been generally invaded by poor quality units and the success of the product as a whole will depend upon the extent to which only satisfactory tile are sold. It would not take long to ruin the industry if poor quality tile were put on the market.

Types of Tile

Concrete floor tile are usually made in 4- by 4-inch, 6- by 6-inch and 8- by 8-inch sizes. The 6- by 6-inch size has been found to be the most popular and is used for residence, store and office floors, mantel hearths, side walls, etc. The 8- by 8-inch size is used primarily in large floor areas such as hotel and club lobbies, automobile showrooms, etc. The smallest size is particularly well suited for making mantels, for bathroom and kitchen floors and walls, etc. The 4-inch tile are about ⅜-inch, the 6-inch, ½-inch, and the 8-inch tile ¾-inch, thick.

In addition to these standard sizes, some manufacturers make a step tile which is used for stair treads, mantel tops, and similar places where corners are formed. They have rounded edges and "bull noses." Another tile sometimes made is used for baseboards. This is usually about 5 by 8 inches in size and one of the top edges is curved.

Any range of plain colors or combinations of colors may be used. Intricate patterns, as shown in some of the accompanying illustrations, are practical. It is in this matter of color that the tile manufacturer must be particularly careful. Only the best qualities of mineral pigments should be used.

Some tile are made by exposing specially selected aggregates to obtain the desired surface color and effect.

Manufacturing Methods

Concrete floor tile are made on machines, several makes of which are available. One of the principal requirements for making good floor tile is the use of high pressures for compacting the concrete. These pressures in some instances are used as high as 4,500 pounds per square inch, though much lower pressures have been used with success. Some of the tile machines use hydraulic pressure, some oil, some hand screws, and some operate by a foot pressure arrangement. For some time it was thought that the hand or foot pressure machines were not satisfactory but several manufacturers have used them in recent years with success.

Intricate patterns worked out in a variety of colors have been successfully made with concrete floor tile

Tile machines consist of a frame built to hold a working table, a firm metal mold and an arrangement for applying the pressure needed to compact the tile. The bottom of the mold consists of a solid and very smooth piece of steel. Pressure is applied either downward or upward or in both directions, depending on the type of machine used.

After the tile has been compressed, it is removed from the mold and placed on some portable table or shelves which convey it to the curing rooms. No pallets are needed as the tile are compacted so thoroughly by the pressure that they can be handled without breakage.

Adequate curing is one of the most important operations in making floor tile. Usually they are handled roughly during the process of placing them on the floor. They are often pounded into place and the tile must be well cured to permit such handling.

An example of the use of plain colored concrete floor tile

Some manufacturers dip the tile in water before taking them to the curing rooms. Others carry them directly into the kilns where they are kept damp and warm for a period of at least a week. After that they should be air cured until they are at least a month old. One very successful tile manufacturer will not allow his tile to go out of storage until they are three months old. It is advisable to keep the tile stored under cover even after they are taken from the curing rooms.

Various kinds of hardeners and admixtures are often used to give the tile greater strength and a harder wearing surface.

Proportions

All concrete floor tile are made with special facing mixtures. These may be obtained by the use of color pigments or with special aggregates as in some cast stone and in terrazzo work.

The method of making colored pigment tile is as follows: First the materials for the wearing surface are proportioned and mixed. This wearing surface consists of a mixture of cement and pigment. As mentioned before, only mineral pigments should be used. It is important that the pigment be purchased from a reliable company that makes a specialty of pigments for use in mortar or concrete.

Do not add more pigment than is necessary to obtain the color desired. Usually this amount is less than 10 per cent by weight of the cement and the use of a greater amount than this should be viewed with caution. The pigment and the cement should be thoroughly mixed in a ball mixer. When light colors are desired a white portland cement is recommended.

Water is added to this mixture of cement and pigment until it becomes a slurry having a consistency that will just permit it to be poured. The wet slurry is then thoroughly mixed and a layer of about ⅛ to ¼ inch in thickness is placed on the smooth metal bottom of the mold.

It is absolutely necessary that the smooth metal plate be absolutely clean. The smoothness of this surface covered with a film of oil gives the surface of the tile its gloss and smoothness. After each tile is made, this metal surface should be cleaned with a hair brush that contains a small amount of some light oil.

After this is done, some ordinary portland cement is sprinkled through a sieve onto the color, just enough being used to form a film over the slurry. This is followed by the base course which fills the remainder of the mold, the pressure is applied and the tile is ready for curing.

The aggregate for the base course usually consists of a coarse, well graded sand or limestone screenings. Some manufacturers use material having particles up to ⅜-inch in size. The mixture used is 1 part of cement to from 2 to 3 parts of aggregate. Only enough water is used to make the concrete of a consistency similar to that used in making dry tamp block.

Designs are obtained by placing several colors in a pattern as desired. The pattern is made by means of metal strips bent and formed to the outlines of the design to be used much like the "cookie cutters" that are used for making Christmas cookies. The various colors are then placed in the spaces assigned to them, the metal pattern is carefully removed and the work proceeds as in plain colored tile.

Special Aggregate Facings

The surface finish of tile in which aggregates are exposed to obtain the surface finish is made very much like the pigment tile except that other materials are chosen for the surface layer. In making these tile the surface layer consists of some specially selected aggregate, usually crushed marble or granite or prepared aggregate, mixed in the proportions of 1 part of cement to 2 parts of aggregate. The facing aggregate should be well graded from ¼ to ½ inch maximum size down to material that will just be retained on a sieve having 8 meshes per linear inch. As in the first method, the facing material is mixed rather wet and the backing dry. The final finish is given by grinding the surface with sand on a wheel and polishing with carborundum wheels.

It is important that the mold is always filled exactly to the same level and that the same pressure be applied to each tile. If this is not done, tile of varying thicknesses are liable to result and that complicates the work of the tile setter.

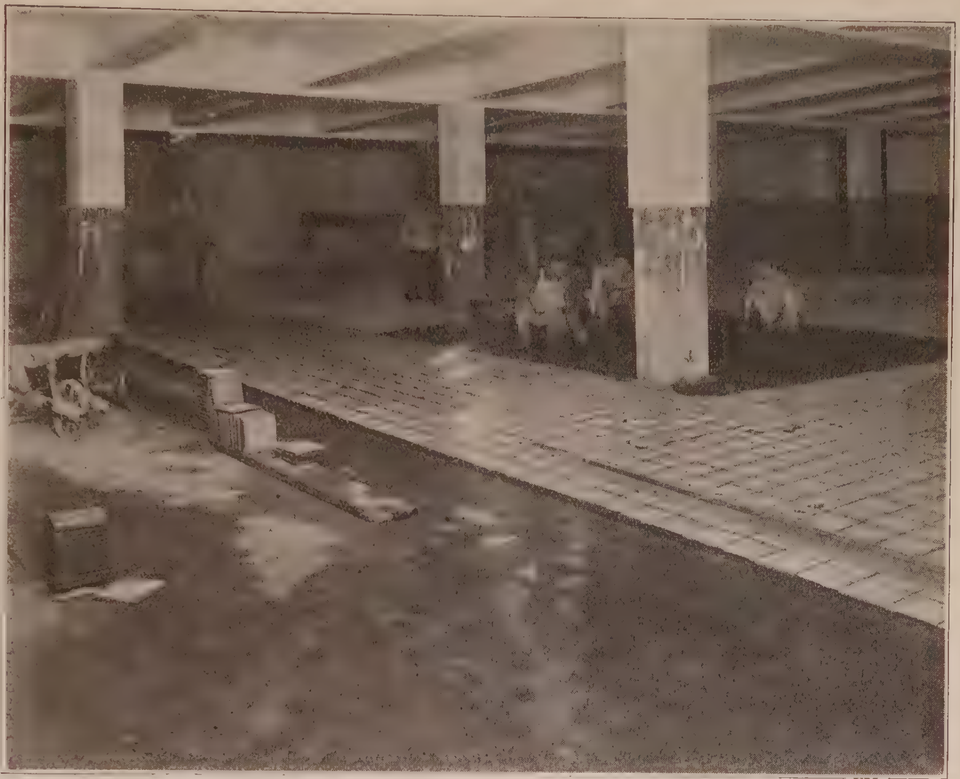
Laying Concrete Floor Tile

The first requirement for successfully laying concrete floor tile is that the floor be firm and free from spring and vibration. Sometimes a levelling coat of concrete is necessary on old, uneven floors to simplify the work of the tile setters and to assure satisfactory results. The tile are laid in a mortar bed composed of a mixture of 1 to 1½ parts of portland cement, ½ to 1 part of hydrated lime and 5 parts of clean, washed sand.

Before laying the tile, soak them in water for from 10 to 20 minutes and then allow them to dry for about the same length of time. It is advantageous to have the tile damp, but not wet, when they are laid.

Lines should be stretched to guide the tile setter in placing the first row of tile. It is best to start at the center of the room so that both sides will be absolutely symmetrical. The guide line should be supported at intervals so that it will also serve as a guide for elevation. If the floor area is large and several men set the tile, other lines crossing the first one at right angles, can be stretched.

Only a small amount of mortar—enough for 3 or 4 tile—should be spread at one time and all joints of unfinished portions should be levelled off. Use a square and level on every course to be sure that the tile are placed evenly and that the joints are uniform. As the tile are placed in the mortar they should be tamped down with the handle of a hammer or trowel until their elevation is exactly equal to that of the other tile.



Placing concrete floor tile. Proper laying is as essential as careful manufacturing if a satisfactory floor is desired

In case the dimensions of the room do not fit a multiple of the tile dimensions after the border is allowed for, a fractional tile can be used to fill the space. When this extra space is less than one inch it may be filled with a mortar of equal parts of portland cement and sand, colored to match the tile.

Six or seven hours after the tile have been laid, the floor should be washed with plain water. The seams can then be filled with a thin mixture of water and cement by sweeping the mixture over the floor with a broom. The surplus grouting material can be removed with sawdust and excelsior or bagging. Do not allow anyone to walk on the floor during the first 24 hours after it is finished.

A white scum, caused by the cement, sometimes appears on the surface of the floor tile. This can be removed by frequent washings with soap and water. After the floor has been down for about two months, a thin wax such as is used to polish wood floors may be applied. The tile will develop a natural gloss which will improve with age.

Cost

There is a wide range of cost in floor tile equipment. Some of the machines in which pressure is applied manually can be purchased for around $500, while imported tile machines, operated by hydraulic or oil pressure, will cost about $5000. The price includes all the equipment necessary for applying pressure.

One manufacturer, using a mechanical pressure machine, reports that one man, doing his own mixing and putting the tile in the curing room himself, can make

TILE PER DAY	SIZE
200	8- by 8-inch
225	6- by 6-inch
400	4- by 4-inch
100	step tile
100	base tile

Selling prices range from 10 cents each for the plain 4- by 4-inch tile, 15 cents for the plain 6- by 6-inch tile to 35 cents for the 8- by 8-inch pattern tile. Base and stair tile are sold at about 35 cents each.

The cost of laying concrete tile is about 35 cents per square foot. Cost of placing baseboard tile is estimated at 35 cents per linear foot. Tile manufacturers estimate the average cost of concrete floor tile in place at from 60 to 70 cents per square foot.

American Construction Council Sessions

According to Dwight L. Hoopingarner, the council's executive, the sixth annual convention of the American Construction Council at the Hotel Statler, St. Louis, Missouri, on December 1st to 3rd, will center around the subject of "Assaying the Construction Industry—Its Needs and What Should Be Done About Them."

Power Exposition Exhibits Have Interest for Concretor

Commencing the week of December 5 the National Exposition of Power and Mechanical Engineering will be held at the Grand Central Palace, New York City. While the majority of exhibits are for mechanical engineers, several, such as those of machine tools and woodworking machines, will interest concretors.

High Early Strength Concrete Speeded Edison Co. Contract

By LEONARD C. CHILDS
Manager, Building Department, Bates & Rogers Construction Co., Chicago-Cleveland

HIGH early strength concrete, that at 3 days was practically as strong as ordinary concrete is at 28 days, was secured in an important public utility job in the construction of foundation slabs and manholes at the Fisk Street Station of the Commonwealth Edison Co., Chicago, with a standard brand of portland cement.

Mix Control

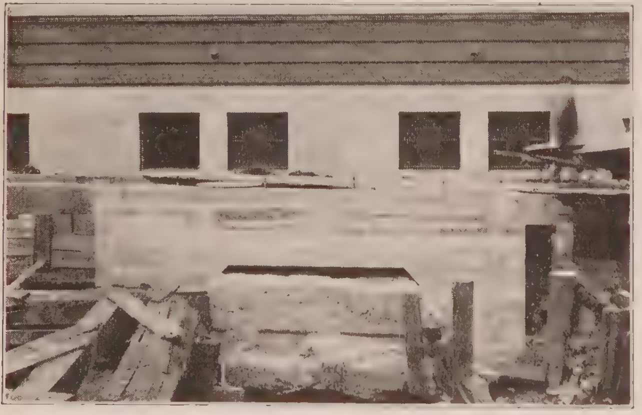
Speed was necessary on this project. The Edison Co. wished to extend its system of conduits rapidly and to do so needed foundations and manholes for them without delay. Laboratory tests and field experience have proved to us that high early strength concrete can be obtained if rules of proportioning, mixing, placing and curing are carefully followed.

Methods Used

The concrete was all reinforced, portions of it containing two rows of corrugated steel bars. The materials and proportions used were as follows:

Aggregates: Washed sand, 0 to ¼ inch
  Crushed limestone ¼ to 1 inch
Bulking of sand: 20 per cent
Moisture in sand: Average 0.6 gallons water per cu. ft.
Proportions: 2 sacks cement.
  3 cu. ft. sand (damp and loose)
  5 cu. ft. crushed limestone
Total Water: 9 gallons per batch
Water-cement ratio: 4.5 gallons per sack
Real mix: 1:1.2:2.5
Cement Content: 8.4 sacks per cu. yd. concrete
Mixing Time: 60 seconds per batch
Slump: (estimated) 2 inches.

Moisture in the sand was ascertained and allowance for it was made in following the water-cement ratio of 4.5 gallons of water to a sack of cement.



The large beam supporting trestle. Note the difference in the surface appearance of the new concrete in the beam and that of the old concrete, underneath the beam arch, which was later removed

High Early Strengths Secured

In order to determine strength of the concrete, seven 6- by 12-inch test cylinders were made, one cylinder being from each of seven different batches. These cylinders were cured for 3 days under job conditions and tested at the laboratory of the American Bureau of Inspection and Tests. Four cylinders were tested when 3 days old and 3 were stored in the laboratory for 4 days and broken when 7 days old. The following are the results of tests as submitted by the laboratory:

Cylinder Number:	Age days	Compressive Strength lb. per sq. inch	
1	3	Av. 1845	1740
2	3		2120
3	3		1710
4	3		1810
5	7	Av.3300	3500
6	7		2950
7	7		3460*

The four specimens tested at the age of 3 days gave an average compressive strength of 1,845 lb. per sq. in. Cured on the job, they had been exposed to the weather at an average temperature of but 55 deg. Fahrenheit for 3 days. Altho cured under unfavorable low temperature conditions for high early strength concrete, this concrete developed nearly 2,000-pound strength in 3 days. Had the temperature been 70 deg. Fahrenheit or over, the strength of this concrete at 3 days would have been more than 2,000 per sq. in.

Some unusually high early strengths were obtained in the concrete used on this rush job. Standard portland cement was used

The average strength of the three cylinders tested at 7 days was 3,300 lb. per sq. in. or some 1300 lb. greater than that of ordinary concrete in 28 days. This is a highly satisfactory value and, as noted, is greater than the strength usually expected of ordinary 28-day concrete. This high strength at 3 and 7 days was due to the use of a low water-cement ratio of 4.5 gallons of water per sack of cement. The mixing time, process of curing, and other phases of the work were the same as for ordinary concrete.

The methods used were profitable for the owner as they permitted the Commonwealth Edison Co. at slight extra expense to put the substantial improvement into speedy service thereby giving quicker returns on the investment. They benefited the contractor and engineer by enabling them to secure high early strength quality concrete that is permanently better than ordinary concrete with but slight additional trouble. The results were so satisfactory that we plan to use these methods on other projects where speedy construction is essential.

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*Average strength of ordinary concrete at 28 days is 2,000 pounds at 72 deg. Fahrenheit curing temperature.

Essentials of Rigid Frame Design

A Detailed Discussion of the Proportioning of the Cross Sections—Computing Steel Reinforcement — Details of Placing Steel — Conclusion

By **E. H. HARDER**
Assoc. M. Am. Soc. C. E., Consulting Engineer, Concrete-Steel Engineering Co.,
New York, N. Y.

Part III

EVEN the latest textbooks on reinforced concrete offer no direct method of proportioning the amount of reinforced concrete needed in a given section for combined bending and thrust. It is largely a question of cut and try, in which process the engineer is assisted by tables or curves. The methods offered in Part III do not entirely eliminate some cut and try, but the computer is enabled to quickly reach definite conclusions not possible with the present curves at his disposal.

The first case to be treated is that of a thrust with small eccentricity causing compressive stresses over the entire section; second, the case where the eccentricity is large causing tension over part of the section, no reliance being placed on the tensile strength of the concrete, and third, the case of two different thrusts accompanied by moments of opposite signs. Wherever possible, the notation used is the same as used in standard textbooks.

Core Point Distance

It is well known that, for a plain rectangular section, the core points lie at the extremities of the middle third. By adding reinforcing near the edge of the section, the core points move outward and away from the center of the section. The greater the amount of this reinforcing, the farther do the core points move away from the center of the section. With the displacement of the core points, there is a corresponding change of stress distribution in the section. Since at the outset, the percentages of reinforcement are not known and, furthermore, since both compression steel areas need not be alike, we may choose an average value of the core point distances which would give approximate values of the fibre stresses. To make this selection, it is necessary to know the limits within which the core points lie for different percentages of steel reinforcing. Fig. 3 shows the variation of the core point distance from the center of the section for steel percentages from 0 to 10 and for variable distances of the steel from the outer edges of the section. Thus $\varrho = \frac{d'}{t}$. From these curves it is apparent that the core point distance varies from $\frac{1}{6}t$ for the plain section to about $\frac{1}{3}t$ for the same section reinforced by 10 per cent steel. The designer will, therefore, not go very far wrong if he selects $\frac{1}{4}t$ for the core point distance for his preliminary calculations and experience has shown that this assumption leads to results which satisfy all conditions fully.

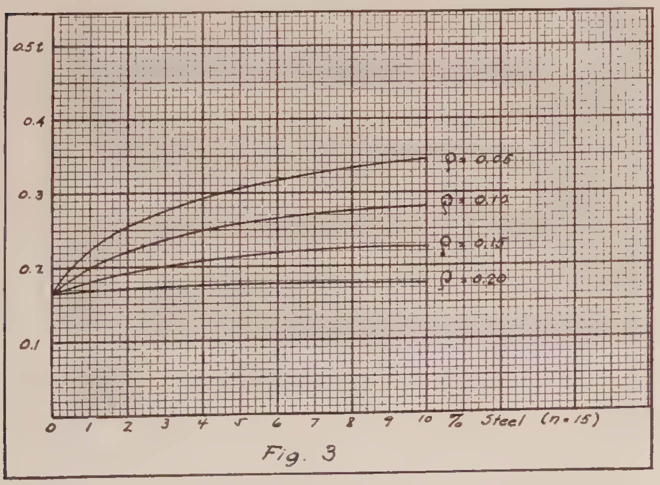


Fig. 3

Stress Distribution

If the eccentric thrust acts within the core points, no tension will exist in the section. The compression reinforcement, which will be needed, must be made so large that the allowable extreme fibre stress in the concrete will not be exceeded. A graphical construction offers the most convenient method of solving this problem. (See Fig. 4.) It will be necessary to know how much of the total load N will be carried by the concrete and then the balance will be carried by the steel. To compute the former it is

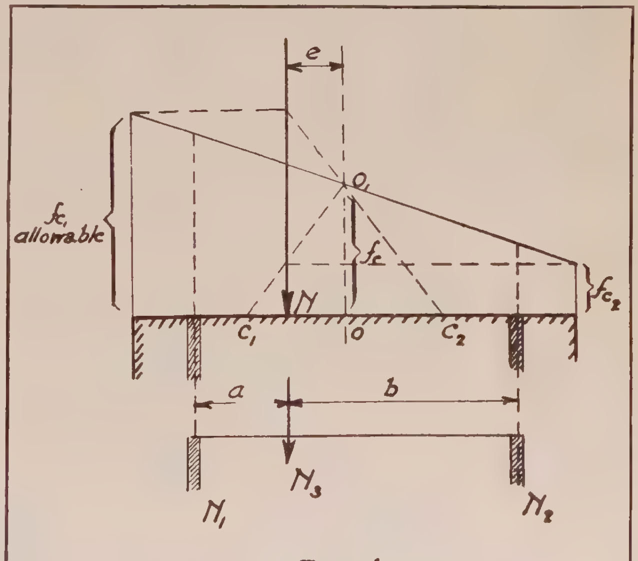


Fig. 4

necessary to find the average stress f (see Fig. 4) and then multiply by the total concrete area. To find f, lay off the allowable fibre stress fc_1, on the line of action of the eccentric thrust N. Connect this point with core point C_2 and where this line will intersect the centerline of the section at O_1, the distance $O\text{-}O_1$ will be equal to the average stress f as measured by the same scale employed in laying off fc_1. The remainder of this part of Fig. 4 needs no further explanation. The load carried by the concrete will be $Nc = btf$ where b is the width of the section and t the total depth.

The load carried by the reinforcing steel will be $Ns = N - Nc$. This load Ns is split up between the two compression steel areas according to the law of the reactions of a simple beam. Thus N_1 is $\dfrac{Ns.b}{a+b}$ and N_2 is $\dfrac{Ns.a}{a+b}$. Having completed the stress distribution as shown in the upper part of Fig. 4, we may scale the concrete stresses at the locations of the steel inserts. Then N_1 and N_2 are divided by n— times these scaled concrete stresses to determine the areas of the reinforcing needed. The following example will elucidate this principle.

Given a plain concrete section 12x30 in. upon which acts a thrust of 150,000 lbs. and a moment of 840,000 in. lbs. $e = 5.6$ in., find the necessary reinforcing steel so that a maximum allowable concrete fibre stress of 600 lbs. per sq. in. will not be exceeded.

The graphical construction of Fig. 5 needs no further explanation. Here the average concrete stress is 4,100 lbs. for the 12-in. width. The total stress carried by the concrete is therefore 4,100 × 30 or 123,000 lbs., leaving 150,000 — 123,000 or 27,000 to be carried by the reinforcing steel.

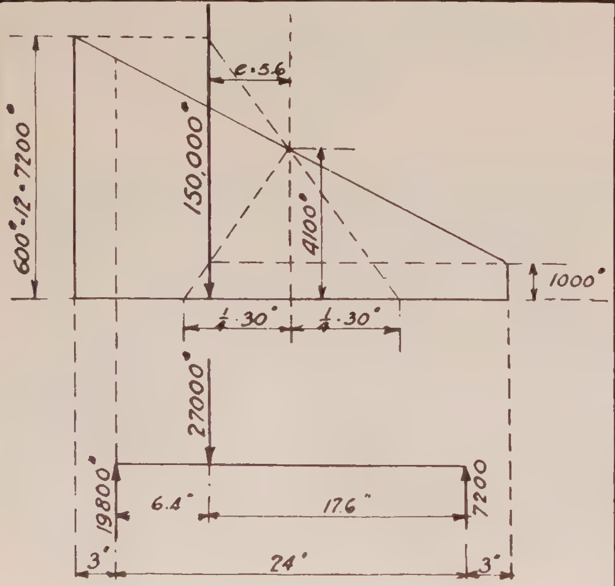


Fig.5

As shown in Fig. 5, 19,800 lbs. is carried by the steel to the left and 7,200 lbs. by the steel to the right. At the location of these steel areas, the concrete stresses are 550 and 137 lbs. per sq. in. respectively. Therefore the steel area on the left is

$19{,}800 \div 15 \times 550 = 2.40$ sq. in., and the steel area on the right is

$7{,}200 \div 15 \times 137 = 3.50$ sq. in.

Using 2 — 1 in φ bars at 2.36 sq. in. for the former and 2 — 1 in. φ bars plus 2 — 1 in. ☐ bars at 3.57 sq. in. for the latter and checking the stresses by the usual method of transformed sections, we obtain 612 lbs. per sq. in. for fc_1 and 73 lbs. per sq. in. for fc_2.

If the normal thrust acts outside of the core points then we shall have tension on the opposite side of the section and the farther the normal thrust acts from the core points the greater will be the tension.

In Fig. 6, let N be the eccentric thrust acting on the section at a distance e from the axis of the frame. If M is the bending moment at this section $e = \dfrac{M}{N}$.

In the plane of the lower steel, let two equal and opposite forces act, each to be of the same magnitude N. The equilibrium of the section is thereby not disturbed. Two of these forces with the lever arm η form a couple which must be resisted by the internal stresses in the section.

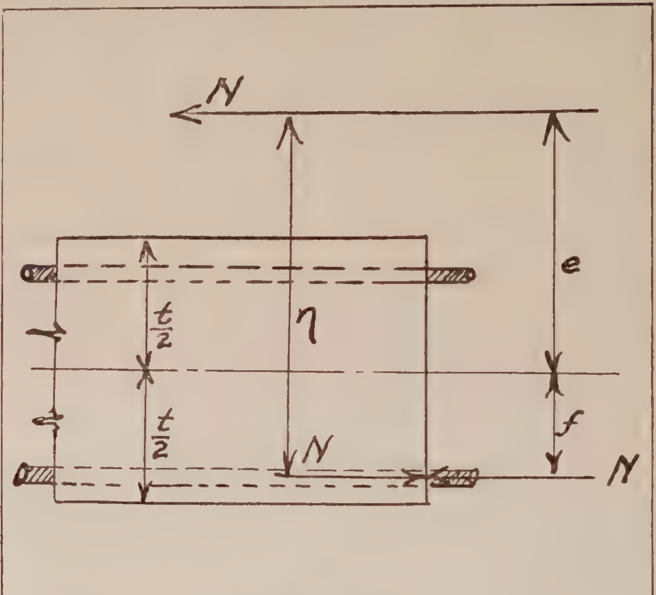


Fig. 6

The remaining N acts in the plane of the tension steel and will be considered later. Knowing e and f, it is a simple matter to determine the moment $N.\eta$ of the eccentric thrust about the center of the tension steel.

Compute the reinforcing needed for the given moment $N.\eta$ for the width of section b and the depth t just as if no eccentric thrust existed and it was necessary to compute the steel needed in a plain concrete section acted upon by any given moment, and for the given stresses fc and fs.

Using standard notation, $x = \dfrac{fc.d}{\dfrac{fs}{n} + fc} = kd.$

Hence $k = \dfrac{n}{n+\nu}$ where $\nu = \dfrac{fs}{fc}$.

The moment, which the concrete can take without exceeding the allowable fibre stress fc, is

$$Mc = \frac{fc.b.x}{2}\left(d - \frac{x}{3}\right) = \tfrac{1}{2}\,(bd^2)\,fc.kj = \frac{1}{2}R\,(bd^2)\,fc.$$

The quantities k, j and R = (kj) may be taken from tables published in nearly every concrete handbook or, perhaps more conveniently from the curves of Fig. 7.

Knowing Mc, we can find the required tension steel as follows: $As_1 = Mc \div jd.fs$.

If $N\eta$ or M_T is equal to Mc, there will be no need for any compression reinforcement. If $M_T > Mc$, the remaining moment $Ms = M_T - Mc$ must be taken up by compression reinforcement $As' = Ms \div h.fc'\ (n-1)$ and the corresponding increase in the tension steel will be $As_2 = Ms \div h.fs$.

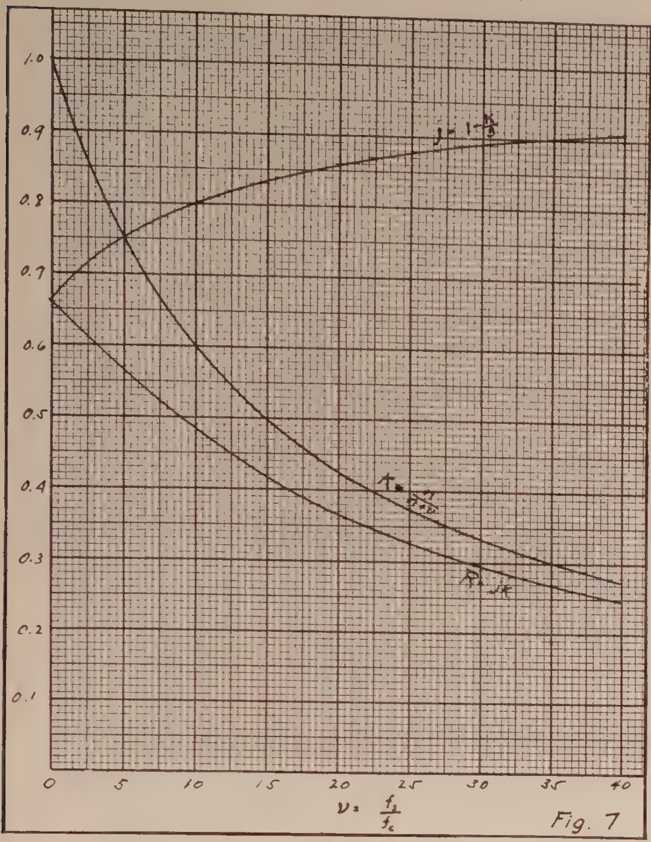


Fig. 7

Compression Reinforcement

Thus, if we were designing the reinforcing for a simple bending moment, the total tension steel would be $As_1 + As_2$ but here we must recall the force N acting in the plane of the tension steel and which did not form part of the couple $N.\eta$. Since this force acts in such a manner to produce compression in the steel, we must reduce the total area of the tension steel as found above, by an amount equal to $N \div fs$. Therefore, for the case of an eccentric thrust acting outside of the core area of a concrete section, the total area of tension steel required is $As_1 + As_2 - N \div fs$.

A check of the correctness of this method can always be obtained by adding algebraically the total internal forces acting to counterbalance the thrust N.

T-Shaped Sections

If the section is a T-section of given dimensions and it is desired to find the necessary reinforcing for an eccentric thrust distant e from the axis of the frame or distant η from the plane of the lower steel, we must split the section into three parts:

1. Stem, in which d = height and b = width. Proceed as before and find M_1 and As_1 for the given allowable stresses fs and fc.

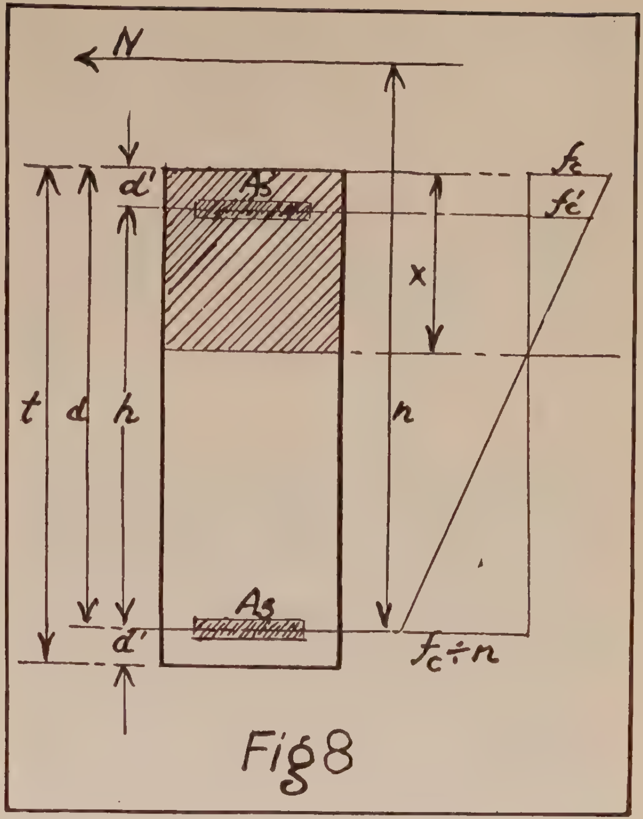


Fig 8

2. Flange having width $b' - b$ and depth t'. The lever arm of the compression center of the flange about the lower steel is approximately $d - \frac{t'}{2}$. (Actually it is $d - \frac{3kd - 2t'}{2kd - t'} \cdot \frac{t'}{3}$). Then $M_2 = \frac{fc + fc''}{2} t' \ (b' - b)\ (d - \frac{t'}{2})$ and $As_2 = M_2 \div (d - \frac{t'}{2})\ fs$.

3. $M_3 = M_T - M_1 - M_2$ and this moment is taken by compression reinforcing and by additional tension steel, $As_3 = M_3 \div h.fs$. The total tension steel required will then be $As = As_1 + As_2 + As_3 - N \div fs$.

If, for example, a section is to be designed as outlined above and N acts in the vicinity but inside of the com-

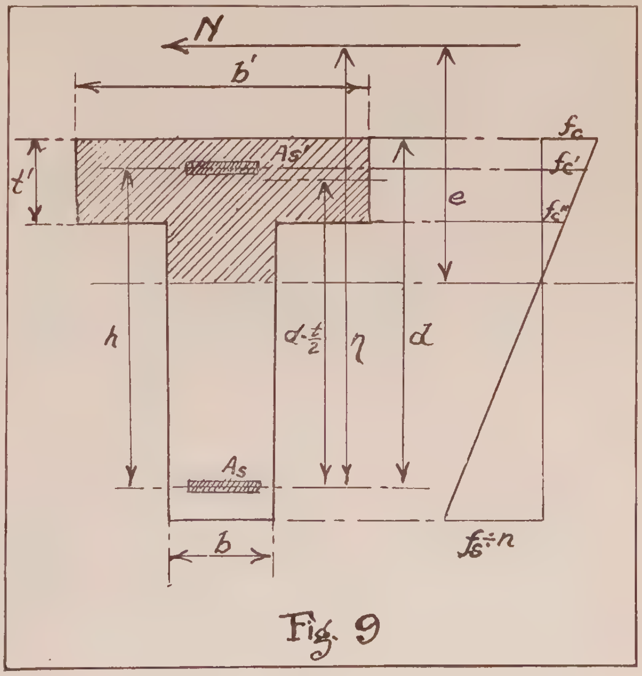


Fig. 9

pression steel, it is possible that, with a high steel stress (tensile), the quantity $N \div fs$ becomes greater than $As_1 + As_2$; i. e., the net tension steel area becomes negative. In such a case, our computation is clearly wrong because the chosen value of fs was too high. We must therefore choose a smaller fs and a correspondingly smaller ν.

The amount of tension reinforcement is dependent upon the will of the designer since, by a proper choice of fs, he can make As equal to a predetermined minimum. Also by several computations (varying fs) he can make As' large or small and so proportion the compression reinforcing so that it becomes a minimum. The aim should be to have a well balanced section with $As + As'$ minimum.

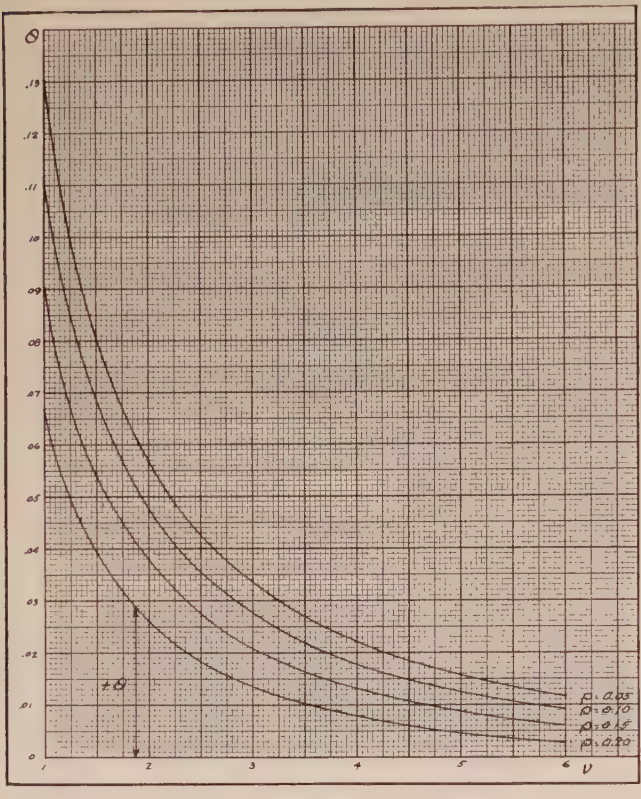


Fig. 10a

For a given tension reinforcement or for a case of reversed moments, as in arches or frames, it often becomes a question of first designing a section for one moment and its corresponding thrust and then testing the section to see if the compression reinforcement, obtained for the first case, is sufficient for the tension requirements of the second case. This would require many trial computations and the work would become too tedious. Following is a method, by means of which one can quickly obtain the proper value of fs for a given tension steel area and for a maximum allowable fibre stress fc.

$$\text{Thus } As = \frac{M_T - Mc}{h.fs} + \frac{Mc}{jd.fs} - \frac{N}{fs}$$

$$= \frac{M_T}{h.fs} + Mc\left(\frac{1}{jd.fs} - \frac{1}{h.fs}\right) - \frac{N}{fs}$$

$$\text{In the first term let } \psi = \frac{d}{h.fs} = \frac{d}{d(1-\varrho)fs} = \frac{1}{(1-\varrho)fs}$$

where ϱ is $\dfrac{d'}{d}$.

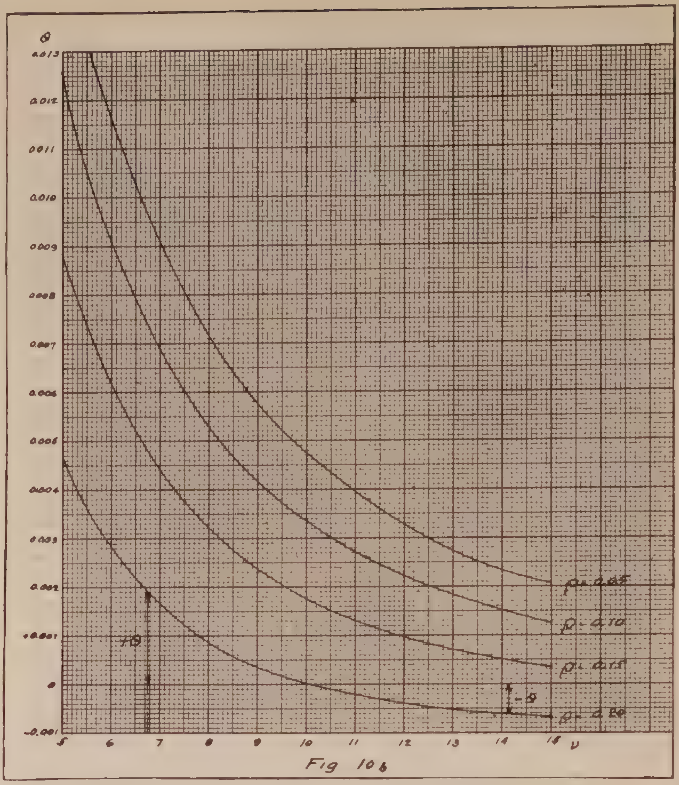


Fig. 10b

In the second term let

$$\theta\, bd = \frac{1}{2} R\, bd^2\, fc\left(\frac{1}{jd.fs} - \frac{1}{h.fs}\right)$$

$$= \frac{k\left(1 - \dfrac{k}{3}\right)}{2\nu}\left[\frac{1}{\left(1 - \dfrac{k}{3}\right)} - \frac{1}{(1-\varrho)}\right]$$

wherein as before, $k = \dfrac{n}{n + \nu}$ and $\nu = n\,\dfrac{(1-k)}{k} = \dfrac{fs}{fc}$.

Substituting the value of $n = 15$ and further simplifying the above

$$\theta = \frac{1 - \dfrac{3\varrho}{k}}{\dfrac{90}{k^2}\left(\dfrac{1}{k} - 1\right)(1-\varrho)}$$

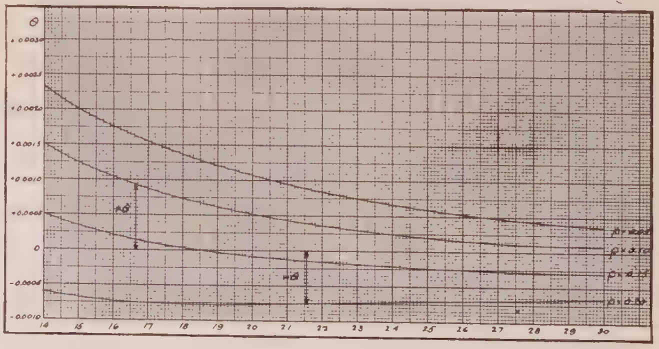


Fig. 10c

The equation for As then becomes

$$As = \psi \frac{M_T}{d} + \theta\, bd - \frac{N}{fs}$$

Dividing by bd, we have

$$\frac{As}{bd} = \frac{1}{d(1-\varrho)}\,\frac{N\eta}{bd}\cdot\frac{1}{fs} + \theta - \frac{N}{bd}\cdot\frac{1}{fs}$$

But $\frac{As}{bd} = p$ and $S = \frac{N}{bd}$.

$$\text{Then } v - \theta = \frac{S}{fs}\left(\frac{\eta}{d(1-\varrho)} - 1\right) = \frac{S}{fs}\left(\frac{\eta}{d-d'} - 1\right)$$

$$= \frac{S}{fs}\left(\frac{\eta - d + d'}{d - d'}\right) = \frac{S}{fs}\left(\frac{\eta - h}{h}\right) = \frac{S.r}{fs}$$

$$\text{Or, } fs = \frac{S.r}{p - \theta}$$

In the above $\eta - h$ is the eccentricity of N with respect to the compression reinforcement and $r = \frac{\eta - h}{h}$ is the relative eccentricity of N with respect to the lever arm of the compression reinforcing.

If the normal thrust acts outside of the compression reinforcing area r is $+$; if inside r is $-$. The numerator is easily determined and is constant for the given problem.

In the denominator, p is the ratio (not percentage) of given tension reinforcement and θ is the unknown function of ϱ and ν and may be obtained from the curves of Fig. 10.

The problem is to find that value of ν which satisfies the equation $fs = \frac{S.r}{p - \theta}$.

The following example will serve to clarify the foregoing discussion. To the casual reader, the work involved may seem arduous but with a little practice the problem may be solved with minimum labor. Example:

Given $N = 58{,}300$ lbs. $M = +764{,}000$ in. lbs.
$N = 43{,}600$ lbs. $M = -615{,}000$ in. lbs.
$b = 12$ in., $t = 27.5$ ft., $d' = 2.5$ in., $h = 22.5$ in., $d = 25.0$ in.
Max. concrete stress $fc = 600$ lbs. per sq. in.

First case; $N = 43{,}600$ lbs., $M = -615{,}000$ in. lbs.,

$$e = \frac{615{,}000}{43{,}600} = 14.12 \text{ in.}$$

$\eta = 14.12 + 11.25 = 25.37$ in.

Select $\nu = 18$
$fs = 10{,}800$ lbs. $= 600 \times 18$
$k = 0.455$
$j = 0.848$
$R = 0.386$

$M_T = 43{,}600 \times 25.37 \qquad = 1{,}105{,}000$ in. lbs.
$Mc = \frac{1}{2} \times 0.386 \times 12 \times 25^2 \times 600 = \quad 869{,}000$ in. lbs.

$Ms \qquad = \quad 236{,}000$ in. lbs.

$$As' = \frac{236{,}000}{22 \times 14 \times 468} = 1.64 \text{ sq. in.}$$

$$As = \frac{236{,}000}{22.5 \times 10{,}800} + \frac{869{,}000}{0.848 \times 25 \times 10{,}800} - \frac{43{,}600}{10{,}800} = 0.73 \text{ sq. in.}$$

Total steel area $= 1.64 + 0.73 = 2.37$ sq. in.

With a selected value of ν equal to 18, the computed compression steel when compared with the area of the tension steel is too large. By increasing the tension steel and allowing a smaller fs it is possible to decrease the necessary compression steel.

Try $\nu = 16$
$fs = 9{,}600 = 600 \times 16$
$k = 0.484$
$j = 0.838$
$R = 0.406$

$M_T =$ (same as before) $\qquad = 1{,}105{,}000$ in. lbs.
$Mc = \frac{1}{2} \times 0.406 \times 12 \times 25^2 \times 600 = \quad 913{,}000$ in. lbs.

$Ms \qquad = \quad 192{,}000$ in. lbs.

$$As' = \frac{192{,}000}{22.5 \times 14 \times 476} = 1.28 \text{ sq. in.}$$

$$As = \frac{192{,}000}{22.5 \times 9{,}600} + \frac{913{,}000}{0.838 \times 25 \times 9{,}600} - \frac{43{,}600}{9{,}600} = 0.89 \text{ sq. in.}$$

Total steel area $1.28 + 0.89 = 2.17$ sq. in.

A further reduction of the value of ν might result in a further decrease in the total amount of steel needed.

It will next be necessary to provide sufficient reinforcing for the second condition, viz.: $N = 58{,}300$ lbs. $M = +764{,}000$ in. lbs. For this case

$$e = \frac{764{,}000}{58{,}300} = 13.10 \text{ in. and } \eta = 13.10 + 11.25 = 24.35 \text{ in.}$$

Compression and Tension

The previously computed compression steel area of 1.28 sq. in. will now become the tension steel area, because the sign of the bending moment is reversed, and the problem is to find out if 0.89 sq. in. (tension steel of first case) is sufficient for compression reinforcing in the second case; always keeping the maximum concrete stress fc at 600 lbs. per sq. in.

$$p = \frac{1.28}{12 \times 25} = 0.00427 \qquad S = \frac{58{,}300}{12 \times 25} = 194.3$$

$$r = \frac{24.35 - 22.5}{22.5} = +0.0822 \qquad \varrho = \frac{2.5}{25.0} = 0.10$$

$$fs = \frac{194.3 \times 0.0822}{0.00427 - \theta} = \frac{15.98}{0.00427 - \theta}$$

Try $\nu = 14$	$\theta = 0.00152$	$fs = 5{,}810$ lbs.
Try $\nu = 13$	$\theta = 0.00183$	$fs = 6{,}550$ lbs.
Try $\nu = 12$	$\theta = 0.00224$	$fs = 7{,}870$ lbs.
For $fc = 600$		$fs = 8{,}400$ lbs. per sq. in.
and the above		$fs = 7{,}800$ lbs. per sq. in.
values of ν		$fs = 7{,}200$ lbs. per sq. in.

It is apparent that the correct value of ν lies between 12 and 13.

Try $\nu = 12.20$, then fs according to formula is 7,360 lbs. per sq. in. and fs corresponding to $fc = 600$ lbs. per sq. in. is 7,310 lbs. per sq. in. The agreement is close enough and $\nu = 12.20$ will now be used for the steel area computations.

$k = 0.552$
$j = 0.816$
$R = 0.451$
$fs = 7{,}310$

$M_T = 58{,}300 \times 24.35 \qquad = 1{,}420{,}000$ in. lbs.
$Mc = \frac{1}{2} \times 0.451 \times 12 \times 25 \times 600 \quad = 1{,}014{,}000$ in. lbs.

$Ms \qquad = \quad 406{,}000$ in. lbs.

$$As' = \frac{406{,}000}{22.5 \times 14 \times 491} = 2.63 \text{ sq. in.}$$

$$As = \frac{406{,}000}{22.5 \times 7{,}310} + \frac{1{,}014{,}000}{0.816 \times 25 \times 7{,}310} - \frac{58{,}300}{7{,}310} =$$
1.28 sq. in.

The result of the computation for *As* checks the starting assumption that the area of tension steel shall be 1.28 sq. in. For the first case, we computed the tension steel area to be 0.89 sq. in. which, for the second case of moment with reversed sign, would be subjected to compression. Above, however, we computed that we needed 2.63 sq. in. of compression steel. Therefore, we need 2.63 — 0.89 or 1.74 sq. in. more steel to be added to the tension steel of the first case to fulfill the conditions imposed upon us.

Computations of the above character must be made for a number of critical points on the frame. Such points are to be selected where bending moments are maximum or minimum or where the section changes abruptly. An inspection of the results of the frame calculations will readily disclose those points at which it is necessary to compute the areas of steel needed. Between those selected, it may be permissible to interpolate the steel areas required.

Finally, in drawing the steel in the elevation of the frame, one must take care that the ends of the bars are properly anchored or extended far enough to thoroughly develop the full strength of the bar. At corners or junctions between columns and arch, the bars must be so anchored that they can perform the function for which they are intended. For instance, if a tension bar is curved and lies near the inner face of the frame, it must be anchored at several points by means of stirrups so that the pull on the bar can be developed without tearing through the outer protection concrete.

Summary

While Parts I and II of this article have attempted to explain the essentials of the design of rigid frames in a general way and Part III has discussed in detail the proportioning of the cross-sections of the frame and the necessary steel reinforcement, there are no fixed rules to safely guide the novice. The design of such structures must be tempered by good judgment and common sense and where compression steel is used, it must be so distributed and held in place by substantial ties at frequent intervals, that it will be able to carry such compressive stresses. In general, the same rules which apply to all other types of reinforced concrete structures apply to the design of the rigid frame.

New Method of Arch Design Uses Set of Forms

A new publication dealing with the design of concrete arches, "Analysis of Concrete Arches," by W. P. Linton and C. D. Geisler, has recently been issued by the Bureau of Public Roads of the United States Department of Agriculture. In their treatment of the subject the authors have developed a method which greatly reduces the tedious and complicated processes usually followed in the calculation of arch stresses.

The method makes use of a set of standard forms, based on formulas not greatly different from those found in other texts. Many of the entries on the forms are the same for all arches and can be printed on them; and the authors have presented the various steps in filling out the forms in such a way that the work is largely mechanical and the chances of error greatly reduced.

A copy may be obtained by addressing the United States Department of Agriculture, Office of Information, Washington, D. C.

Bureau Studies Volume Changes of Different Brands of Cement

An investigation has been completed by the Bureau of Standards of the volume changes produced in various portland cements when neat cement specimens are subjected to steaming and boiling tests. Data were secured on 32 different cements when tested by the following four methods: The regular specification test, 5 hours steaming of cement pats; the Le Chatelier tongs test, involving 6 hours boiling; bars 1 by 1 by 6 inches, steamed 5 hours, and measured by a special micrometer, bearing against glass inserts in ends of bars; (d) identical bars and treatment as in preceding test, but measurements made microscopically by comparator, using glass capillary tubing inserts for markers. The neat cement bars were stored in a constant temperature cabinet, maintained at 21 deg. C. (70 deg. F.) prior to test and for one hour after their removal from the steam, when the final measurement was made.

No deductions are herein made as to the relative merits of these cements, as indicated by the results of these tests. However, the following brief observations are interesting:

1. The usual specification test of the neat cement pats did not give any indications of the relative expansive properties of the cements. All of the cements were "sound."

2. The Le Chatelier tongs did not give very concordant results, nor did the results seem to agree very closely with those obtained by methods (c) and (d).

3. Test method (c) showed that the expansion of none of the cements was great compared with what might be expected of those cements which would prove to be "unsound" in the specification tests of pats. However, the tests of the bars did show that the relative expansive properties of some of the 32 cements varied widely, being grouped as follows:

Group	Number of cements in group	Expansion obtained Per cent
1	7	0.000 to 0.010
2	12	.011 to .020
3	7	.021 to .030
4	5	.031 to .040
5	1	.061

4. In general, the results of method (c) were confirmed by method (d), but the latter method did not give such concordant results for individual tests as (c), notwithstanding the more elaborate and precise nature of the comparator instrument. It is thought that slight warping of occasional specimens may have greatly disturbed the relative directions of the glass tubing inserts. Method (d) was much more difficult and consumed more time than method (c).

5. The foregoing is based on the tests of cement mixed to a "normal consistency." The series of tests was then repeated, using a wetter mix, containing 42 per cent of water (per cent by weight of cement). The results obtained confirmed the observations made on the specimens of normal consistency, although some slight changes would be produced in the grouping as given above.

A. G. C. Executive Groups Hold Fall Meeting

One hundred fifty members of the executive groups of the Associated General Contractors of America met for their semi-annual convention on October 17, 18, and 19, at the Hotel Tutwiler, Birmingham, Alabama.

Multiple Arch Dam Construction

Construction Methods Used in Building a Large Multiple Arch Dam in North Carolina—40,000 Cubic Yards of Concrete Used—Form Details

SEVERAL interesting concrete construction practices were developed when a bit of scenic land in North Carolina was taken to create a paradise for those seeking recreation by building a huge dam to impound the waters of a small river, a large concrete hotel, several miles of concrete road, and all the structures necessary to insure a permanent, attractive and unusual resort region. The backbone of this development is a large multiple-arch dam with an over all length of 585 feet and 104 feet high. The lake formed by this great structure covers more than 1,500 acres. The construction features of this development already under way or completed involve an expenditure of more than $3,000,000. The dam and power plant alone cost $900,000.

The region is known as Lake Lure. Asheville, the center of the region, is the gateway to the lake and the woods and mountains of this part of North Carolina. More than 8,500 acres are included in the development of which the lake will be the central feature.

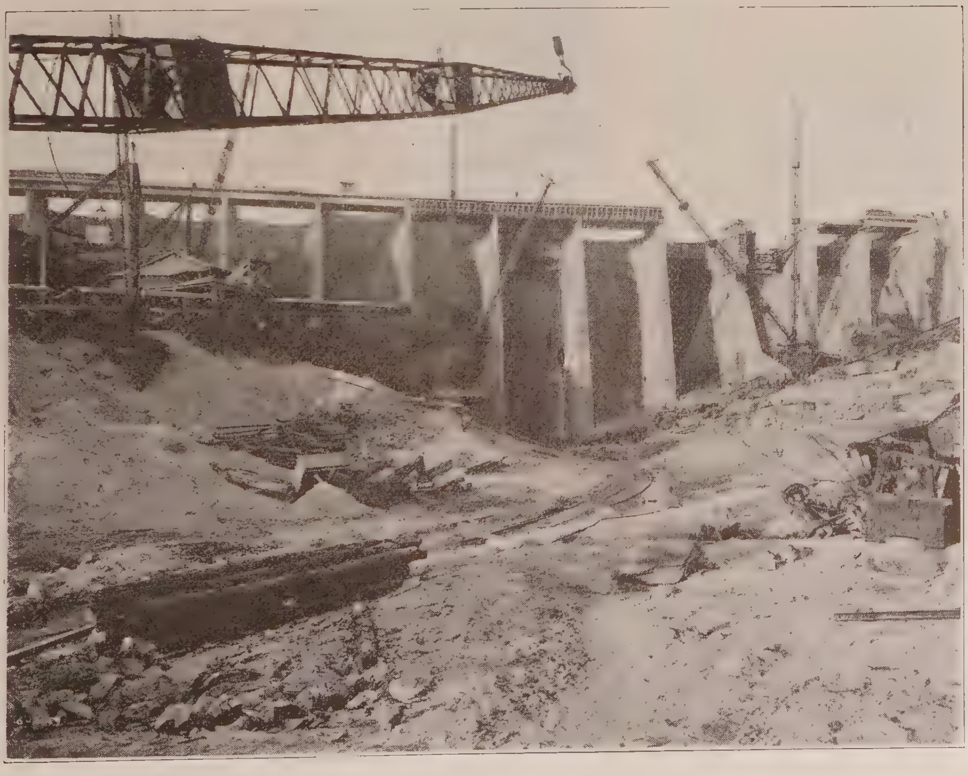
At the point selected as the site for the dam the Rocky Broad River runs in a narrow channel, walled in by high granite cliffs. The river drains an area of approximately 100 square miles, an area largely wooded, with rounded mountains and sheer cliffs and only a comparatively small portion under cultivation. Records compiled over a period of years show that the runoff of the region is ample to maintain the lake level established by the completed height of the dam. At practically all times there will be surplus flow from the lake and a hydro-electric plant has been incorporated as a part of the dam. This plant will have a capacity of 13,500,000 kilowatt hours electrical energy annually.

Construction Methods

Several interesting practices were employed during construction of the dam, one of which was the use of excavated rock for coarse aggregate. The dam rests upon a rocky granite ledge which extends above and below the site. The rock was quarried out of the stream channel for the dam and delivered to an Allis-Chalmers gyratory crusher located about 600 feet below the dam. The crushed rock from this plant was put through a screen for sizing and then conveyed by belt to a bin over the mixing plant just below the dam. In some cases, when the bins were full, the conveyor system delivered the rock to stock piles for storage.

A one-yard Hayward bucket on a guyed derrick handled all the rock from this stock pile to the mixer conveyor system. The sand used on the job was also handled from cars to stock piles or to the mixer by this same derrick. During the course of the work this derrick and bucket handled more than 35,000 cubic yards of materials.

The mixing plant contained a one-yard Smith tilting type mixer. Cement was delivered by motor truck to a storage house located on a hillside above the mixer plant from which it fed by gravity to the mixer. All of the



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The mixed concrete was placed in buckets which were swung on derricks to the point where the concrete was deposited in the forms

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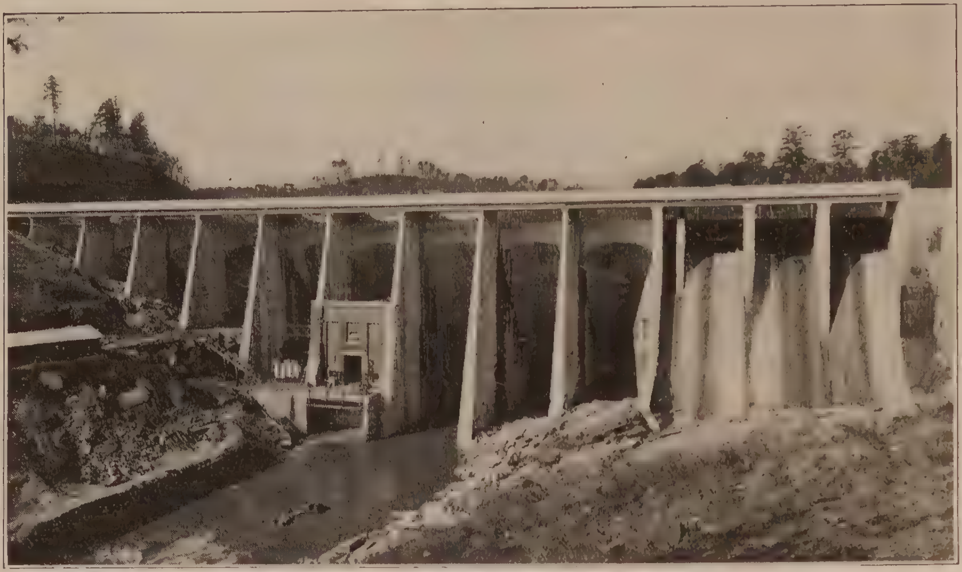

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Three distinct types of dam design were used—the multiple arch, gravity arch and hydraulic core types

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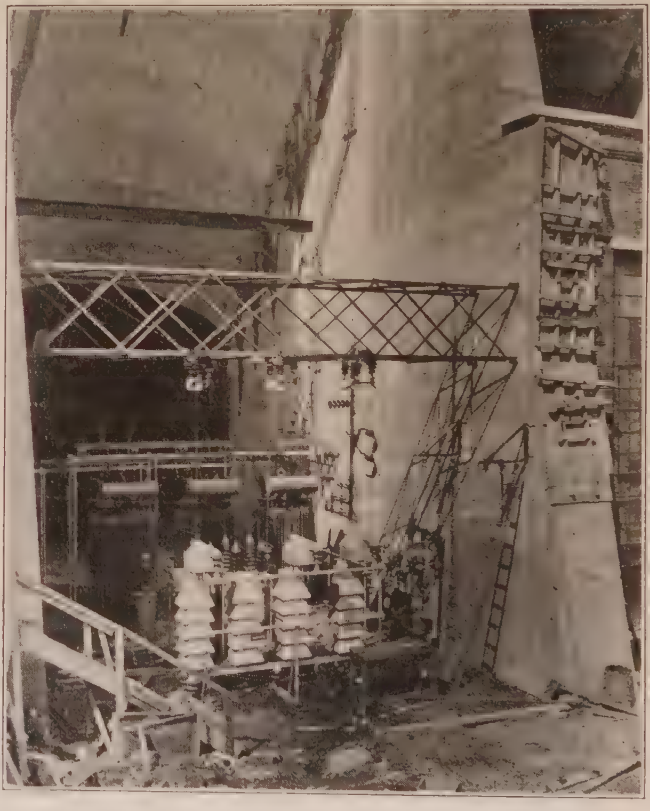
sand used at the mixer was passed through a Blaw Knox inundator under the sand bins. The mixed concrete flowed into buckets and was swung by derricks to position on the dam. The general layout of this plant and its delivery system appears on one of the accompanying photographs, which shows parts of five derricks in operation. Approximately 40,000 cubic yards of concrete were used in the dam and power plant.

The dam is composed of ten arches each 18 feet on centers. Three distinct types of dam construction are employed—the multiple arch; gravity type arch for the spillway; and the hydraulic core beyond the concrete wing built on one end of the dam. The height of the central part of the dam is 104 feet above stream bed and the top of the dam carries a concrete roadway, part of the highway cutting into the resort. This roadway is 133 feet above the base of the dam.

Form Work

The arches of the main part of the dam are built at an angle of 45 degrees with the buttresses and piers upon which these arches rest extending back 165 feet at the base. The contractor worked out a unique system of form work to facilitate placing concrete in the slanting arches. The system adopted follows form work as applied to the construction of cylindrical grain elevators. An inside and outside form of a section height easy to handle was built with small jacks incorporated in the bottoms of the form sections. The forms were first set up on the buttresses carrying the arch. As soon as the concrete of the lowest section had hardened the inside form was lowered slightly by means of the jacks and was then raised along steel channels in the buttresses by means of a line working from one of the derricks. Similar methods were used for outside sections.

In constructing the dam, the buttresses were built first and steel channels placed in the face of these buttresses served as guiding skids to raise the arch forms. When the form sections were approximately in position, exact alignment was gained by leveling with the small jacks. The outside form rested against the face of the buttresses. As the concrete sections were placed, the outside form was raised by the derricks. This method of form placing eliminated the need of shoring and permitted each outside and inside form to be used repeatedly on one arch section.



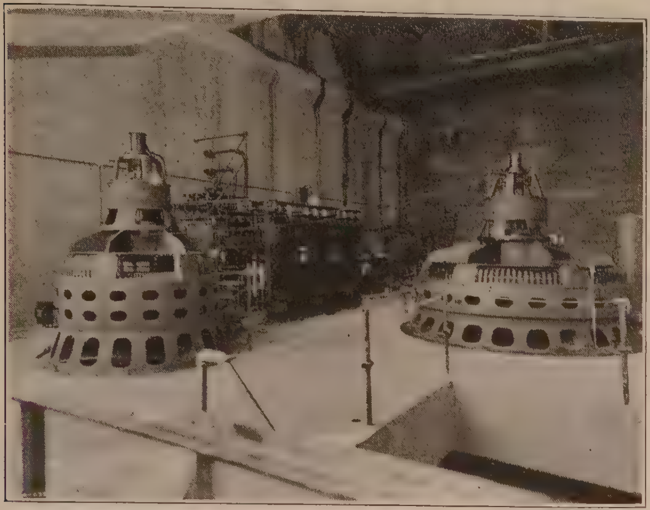
The power house and transformers were located inside the buttresses of an arch

Power House

One of the unique features of this dam is the power house location. Contrary to most construction practices the house was not located below the dam but inside the buttresses on one arch. In the adjoining arch sections the transformers were placed.

The electric plant is remotely controlled. By this means a large operative force at the dam has been eliminated. This is the first example of remote control so far built in the south. Every operation is controlled by engineers located in another power plant, six miles from the dam. Through the adoption of a float type switch, one generator unit will be cut out automatically when the level of the lake has dropped three inches and a second unit will be cut out when the level drops another three inches.

Mees and Mess, of Charlotte, North Carolina, were the designers of the dam and its units. Paul L. Holland was the resident engineer in charge of construction. Clement-Dunavant Company of Charlotte were the general contractors and were represented at the job by George Sibley.



The interior of the concrete power house. It is located inside the buttresses of one arch. In another adjoining section are the transformers. A large operative force has been eliminated by the remote control installed, which is the first in the South

National Crushed Stone Association Meeting

The eleventh annual convention of the National Crushed Stone Association is to be held January 16th to 19th at the West Baden Springs Hotel, West Baden, Indiana. Quarry equipment and machinery exhibitions will be included.

Coming Conventions

December 1st, 2nd, 3rd—American Construction Council, at the Hotel Statler, St. Louis, Missouri. Sixth annual convention.

January 4th, 5th, 6th-National Sand and Gravel Association, at the Book-Cadillac Hotel, Detroit, Michigan. Annual convention and machinery exhibit.

January 9th to 13th-American Road Builders' Association. Cleveland, Ohio. Convention and Road Show.

January 23rd to 27th—Associated General Contractors of America, at West Baden Springs Hotel, West Baden, Indiana. Convention and national construction exposition.

January 16th to 19th—National Crushed Stone Association. West Baden Springs, West Baden, Indiana. Eleventh annual convention and exhibition of quarry equipment and machinery.

February 28th, 29th, March 1st—American Concrete Institute, at Benjamin Franklin Hotel, Philadelphia, Pa. Twenty-fourth annual convention.

New Books

A New Book for the Cast Stone Manufacturer

MANUFACTURE AND USES OF CONCRETE PRODUCTS AND CAST STONE, by H. L. Childe. Published by Concrete Publications, Ltd.

Here for the first time is made available a comprehensible handbook for present and prospective cast stone manufacturers.

The book deals primarily with the various forms of trimstone and ornamental concrete products. It touches also upon a number of specialized products such as posts, roof tile, etc., but it devotes very little space to the common block and tile which occupy so much of the average products maker's time. The book is accordingly one which will be most useful to products men who are planning to extend their line beyond the field of common building units, or who are already manufacturing trimstone or ornamental concrete.

The chapter headings from this book give so clear an idea of the ground which it covers that it would seem advisable to list them. They are, in order: Materials, Proportioning and Grading, Water Content, Mixing, Consolidation, Surface Treatment, Curing, Crazing, Efflorescence and Fading of Colors, Manufacture and Care of Molds, Design of Molds, Plaster, Sand and Other Molds, Roofing Tiles and Memoranda and Index.

The book is beautifully and profusely illustrated, several plates being reproduced in full color. It is well printed on a fine quality paper, and substantially bound in grey boards.

While the book was written with English readers in view, and is in some places somewhat different in its nomenclature than an American book would be, it is nevertheless a book which any American cast stone man is apt to find of considerable value. The beautiful examples of cast stone which supply subject matter for many of the illustrations are alone worth considerable to the man doing creative work in this field.

Index to Proceedings—Vols. 21-25—American Society for Testing Materials

This volume is the third collective Index of Proceedings published by the Society. The first Index covered Volumes 1 to 12 (for the years 1898 to 1912); the second Index covered Volumes 13 to 20 (for the years 1913 to 1920). The present Index is for the five years 1921 to 1925.

The Index contains in addition to a comprehensive subject index of those volumes, an authors' index which lists in the case of each name appearing therein all papers or discussions attributed to that author, or any committee reports bearing his signature, and a complete table of contents of the five volumes covered.

"A Profit in 14-Cent Block!"

Considerable interest has been aroused and a number of comments have come in regarding the article, "A Profit in 14-Cent Block!" appearing on Page 31 of the November issue of CONCRETE. This article will again be discussed in the January issue.

Underwriters' Laboratories' Inspection and Certificate Service *for Products Manufacturers*

Inspection and Certificate Service of Underwriters' Laboratories Replaces Label Service—Purpose is the Same —How New Service Operates

THE label service form of factory supervision operated by the Underwriters' Laboratories of Chicago has been abandoned by this organization and a new service, known as the Inspection and Certificate Service has superseded it. The purpose of the inspection service is similar to that of the label service, namely, to assist the industry in maintaining a product of standard quality and to supply such information as may be needed by regulatory bodies throughout the country regarding the product inspected.

The service has been adopted by a number of products manufacturers who obtain listing as producers of standard products conforming to specifications developed from the researches and tests of the Underwriters' Laboratories. The tests included fire tests and related studies on concrete building blocks.

The inspection and certificate service was designed to operate to the more direct advantage of the products manufacturer. The old label service, in several of its operations, did not operate in the manner anticipated by the laboratories, the manufacturers and the various regulatory bodies recognizing the listed product. Manufacturers were unable to apply the label service to any considerable portion of their production because of the relatively high expense caused by the cost of manufacturing the labels, inspection charges, laboratory test charges and the expense involvel in the attachment of labels to every unit. As a result, labels were attached to only every 10 or 20 units with the thought that this would permit recognition of total production as of standard listed type.

This practice could not be sanctioned by the laboratories as it did not permit close control of inspection in the case of the unlabeled units and did not assure a revenue sufficient to meet label manufacturing and inspection costs. From the standpoint of the insurance rating bureaus and various regulatory bodies governing the use of these concrete products, it was difficult to recognize the labeled product as such because the label was generally covered by the block when laid in the wall.

Under the newer service, certificates of inspection, prepared by the manufacturer and issued by authorized agents of the Underwriters' Laboratories, will be furnished after standard tests are made as evidence to the user of the block and to building authorities that the product covered by that certificate conforms to the requirements of the laboratories. Monthly lists of buildings and other structures for which the block have been certificated will be furnished to district offices of rating bureaus as evidence that the block is of the standard required.

Inspection of the units is made both at the factory and in the field.

The names of listed concrete block manufacturers, together with summaries of the laboratories' reports on their products are kept on cards which are filed at the offices of the principal boards of underwriters and inspection bureaus in the United States and Canada and other interested organizations as well as at the offices and agencies of the laboratories.

Rating bureaus having jurisdiction in New York, Philadelphia and suburbs, Virginia, North Carolina, South Carolina, Georgia, Alabama, Florida, Mississippi, Louisiana, Texas, Arizona, Utah, Nevada, Montana, California, Oregon, Washington and British Columbia are at present recognizing the operation of the service in their territories by adjustments in their insurance rates affecting the listed product. The building inspectors of a number of cities recognize the service as a means by which they can be assured of a standard and uniform concrete block.

Under the label service form of factory supervision, the label charge of $2.00 per 1000 included the manufacturing cost of the label and the inspection charge. It did not include the commercial testing laboratory's charge for compressive strength tests of blocks and analysis of aggregates and made no allowance for different sizes of units. Under the Inspection and Certificate Service the manufacturer is billed at the rate of $1.75 per 1000 sq. ft. of completed wall area, irrespective of the size of the unit. This basis charge includes the inspection charge and the cost of making all tests and analyses of samples.

Detailed information regarding this service can be secured from Underwriters' Laboratories, 207 E. Ohio St., Chicago.

Cinder Block Decision

A suit in which Crozier-Straub, Inc., and Concrete Specialties Co. were the plaintiffs and Robert G. Downer, Atlantic Building Corporation and Seashore Brick and Building Block Company, were the defendants, was tried before Federal Judge J. L. Bodine of the District of New Jersey, and recently decided by him.

The effect of the decision was merely a dismissal of the complaint on the ground that the defendants were not infringers, that is, that they were not making Straub block.

Rail Steel Bar Meeting

The Rail Steel Bar Association held its semi-annual meeting October 27th and 28th in New York.

An interesting feature of the meeting was the showing of a recently completed industrial film, depicting each step of the process of manufacture of rail steel reinforcing bars from the raw material, pig iron, to the finished bar and its use in reinforced construction.

Several copies of this film will be released immediately for exhibition to engineering and architectural societies as well as universities throughout the country.

Service *as an Aid to* Sales

Another Veteran Products Salesman Gives His Views on Selling Concrete Block—He Believes Service to the Buyer Is One of the Most Important Sales Helps—Interests Himself in Prospect's Problems—Gives Help in Design of Buildings

"CONCRETE block are not the easiest thing in the world to sell in our territory," says L. C. Hill of Jacksonville, Fla., in writing about his experiences as superintendent for the Jacksonville Concrete Products Company.

In this respect, Mr. Hill's experiences are similar to those of concrete block manufacturers in many other localities. But Mr. Hill has made a study of his problem and has developed some sales helps that may be of equal value to others who find that "concrete block are not the easiest thing in the world to sell."

"My first step," says Mr. Hill, "is to make a friend of my prospective customer. I am interested in what he is doing. I will make a set of plans for him if necessary. I will work out the details of his job with him. I will take care of his door and window frame order.

"One of the big reasons why the majority of contractors and architects hate blocks is because they get all messed up on their openings. If I can straighten that matter out for them, I have overcome one of the strongest objections to concrete blocks.

"I have even gone so far as to work with the men who make window and door frames and have lined them up on frames that are practical for use with concrete blocks. I try to make it so easy for the contractor or owner to buy concrete block and to make a saving that he actually wants to use them.

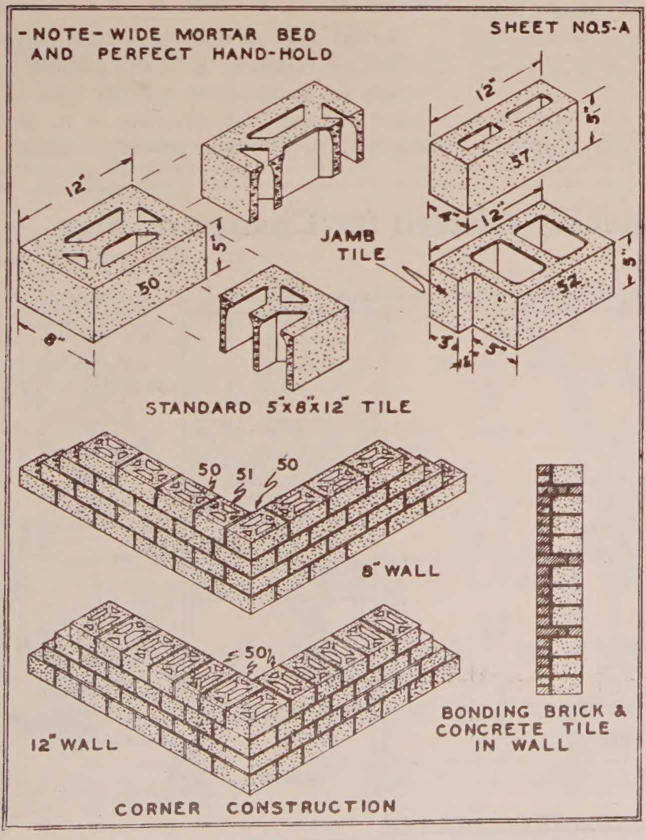
Sees Through Contractor's Eyes

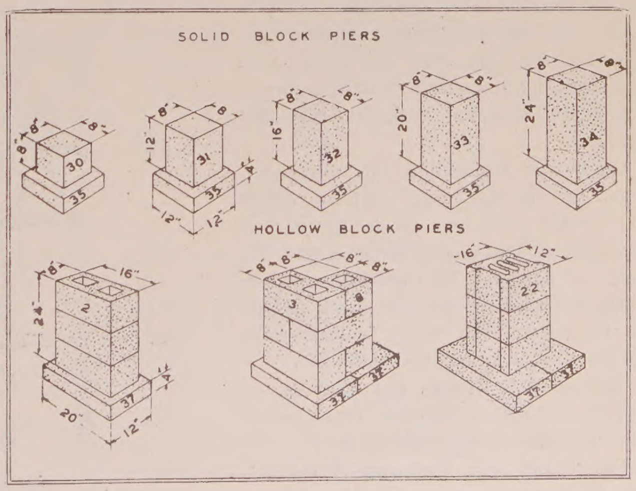
"I have tried to learn the block game from A to Z and to do so I have spent a lot of time learning the other fellow's game. Having contracted myself, I know how he feels. I know what he wants to know. If you can show a man that you can save him money, he is bound to listen to you.

"My cards carry the title *Sales* and *Service* and that is just what I consider myself—a *service* man. I keep posted on all lines of building materials so that I will be able to help my customers. People ask me why I worry around with steel details, steel sash, millwork, roofing details, etc., when my business is selling concrete block. I feel that that is what enables me to render real service and therefore is real selling. I do not believe in 'high pressure' selling. By being helpful to the prospective buyer, I often get the order and have started away when the customer will say, 'By the way, Hill, what are those block worth?' "

In order to help him in his effort to be of service to contractors, Mr. Hill has worked up a series of detail sheets, two of which are reproduced on this page. Whether the prospect ever bought a block or not, he gets all the help that it is possible to give him. Even though there is no assurance that a sale will be made, Mr. Hill will help him work out a sketch for the garage or house he has in mind. He may not sell that particular job, but he has made a friend who will look with favor upon the use of his block when another job comes up.

It is this attitude of seeing the other fellow's problem from his viewpoint and a genuine desire to be of help that this products salesman calls *service*. His opinion is that given an efficient plant, volume, efficient delivery, and a real, honest product, a *service* man will be able to turn a bunch of block machines into a paying business.





Two of the detail sheets worked out by Mr. Hill and given to anyone as a help in designing structures of precast concrete units

New Equipment

New Centrifugal Pump Is Light-Weight and Portable

A pumping unit, known as the Homelite portable centrifugal pump, weighs 95 lbs. and has a capacity of 7500 gallons per hour. It consists of a high efficiency centrifugal pump with bronze open type impeller direct-connected to a 1½-h.p. single cylinder air-cooled motor operating on gasoline or kerosene. Applications are being made in unwatering excavations, manholes and sewers, filling tanks and boilers, handling oil and chemicals, irrigation, and water supply.

Pump and engine are mounted on the same base which also acts as a fuel tank, holding one gallon—sufficient to operate the engine for four or five hours. Oversize Norma Hoffman ball bearings are used for running the shaft. The lift of the pump is 20 feet, and the head, 45 feet. Muddy, gritty water, oils, chemicals, or other liquids that will pass through the foot valve strainer may be pumped. The pump suction and discharge are 2 inches in diameter. The outfit is independent of cooling water supply and can be used even in the lowest temperatures, since the engine is air-cooled. Ignition is supplied by a Robert Bosch High Tension damp-proof magneto.

The unit may be set anywhere without need for foundations, skids, or blocking.

It is now being placed on the market by the Homelite Corporation, Port Chester, New York.

Howe Chain Truck Named "Jak-Tung"

The Howe Chain Company, Muskegon, Michigan, has given the name "Jak-Tung" to its three-wheeled, hauling and storage truck. The truck consists of a platform, equipped with two malleable iron wheels at the rear, and a malleable iron draw bar in the front. The jack tongue, hooks into the draw bar leg, and by a downward thrust of the handle, the load is raised and may be hauled anywhere.

Built in 17 different sizes and three models, with either steel or hardwood platforms or trays, this truck obviously finds its greatest usefulness as a material conveyor in plants, handling loose, bulk, package, or heavy piece equipment up to three tons in weight.

Portable Compressor-Pump Outfit

The Ingersoll-Rand Company, 11 Broadway, New York, has perfected a new combined portable air compressor and water pump outfit. It consists of a standard type Twenty Gasoline-Engine-Driven Portable Compressor and a Cameron Air-Driven Pump. It is suitable for dewatering jobs, and can be used successfully for the elevation of water, for removing the overnight accumulation in ditches and excavations, for cement gun service, and for furnishing water to mixers, etc. The portable compressor, in addition to supplying air for the pump, will run such air tools as rock drills, paving breakers, clay diggers, portable hoists, drill steel sharpeners.

The pump is positive in action, requires no priming and will handle very muddy water. It can also be regulated to any desired capacity within its maximum rating by adjusting the amount of air admitted.

Several sizes of these compressor-pump outfits are available. It is also possible to obtain the pump alone, together with all parts necessary for attaching it to any Ingersoll-Rand Portable now in the field.

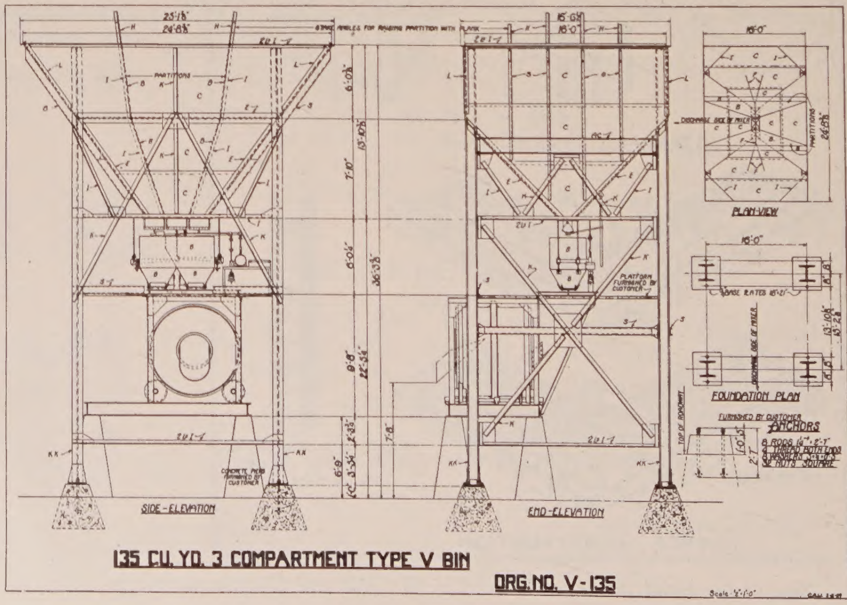
Butler Marketing New Bin That Is Quickly Altered for Change of Mix

The accompanying illustration shows the new Butler central mixing plant with a bin capacity of 135 cubic yards, or 200 tons. The bin has three compartments, one each for stone, slag and sand. Two compartments or smaller capacity bins are furnished where only two materials are required.

Levers for controlling the mixer are found on the operating platform within comfortable reach of a single operator, as are those operating the Butler Type "H" weighing hoppers. The measuring hopper discharges directly into the batch hopper of the mixer. The mixer is located on individual foundations under the bin.

Changing a weight and throwing a lever is all that is required to accommodate a change in materials or mix.

The Butler Bin Company, Waukesha, Wisconsin, manufactures the bin.



Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 West Thirty-ninth St., New York City.

American Road Builders' Association; Chas. M. Babcock, President; Miss E. A. Birchland, Secretary, 29 W. 39th St., New York City.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. 39th St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer Secretary, 1150 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; 123 West Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference of America; H. E. Plummer, President; Fred W. Lumis, City Hall, Springfield, Mass., Secretary.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Concrete Products Association; S. I. Crew, President, Norwood, Ohio; Austin Crabbs, Secretary, Box 343, Davenport, Iowa.

Iowa Concrete Products Association; Floyd Goodrich, President; R. L. Gavin, Secretary-Treasurer, 405 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. E. Coleman, President; A. W. Dickson, Executive Secretary. 2226 Builders Building, Chicago, Illinois.

National Association of Builders' Exchanges; William F. Chew, Baltimore, President; Earl F. Stokes, Secretary, 15 East Fayette St., Baltimore, Md.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East Twenty-second St., New York City.

The National Lime Association; G. B. Arthur, Secretary, 927 15th Street, N. W., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 933 Leader-News Building, Cleveland, Ohio.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

Nebraska Concrete Products Association; A. V. Anderson, President, Reimers-Kaufman Co., Lincoln, Neb.; E. L. Bateman, Secretary, Bethany, Neb.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; A. P. Kuranz. Secretary-Treasurer, 425 E. Water St., Milwaukee.

Mixer Musings

Reported by "Joe"—The Mixer Boss.

Ah, Here's the Short Course Man

Dear Joe:

HEREWITH my humble application for the privileges of the Guild of Certified Slump Testers, and long may it wave.

My first test was in the Purdue laboratory and was made with the 6x12 cylinder used in them days. Since then have designed mixes and made check slump tests in 25 states, so have some hopes of being assigned to the Committee on Consistency.

In conducting short courses for the Portland Cement Association I have an opportunity to see many control jobs, and feel that the slump test has done a big bit for uniform quality.

Kindly inscribe my name upon the fur-lined charter as a sort of unofficial walking delegate for the Guild, defending the principle of Constant Consistency.

Yours truly,

(Signed) *J. W. Kelly*, P.C.A., C.S.T.

Title, title, who's got the title? Everybody who thinks Joe Kelly's got it, say aye.

And a Good Friend from the East

Dear Joe,

EVER since the Guild of Certified Slump Testers was formed I have been intending to send in my application for membership, but I have been so dog-goned busy making the things that I haven't been able to squeeze in the time for a letter.

I can't make any claims for membership on the grounds of time of service to Neptune, or whatever deity will be chosen, as I have only been making slump tests since 1922, but for variety of conditions under which I have made slump tests and the number made I hope to be admitted to the honorable Guild.

During my five years of slump testing I have made slump tests on highways, city streets, sidewalks, bridges, sewers, dams and buildings. I have tested the concrete for bridges almost one hundred and fifty feet above the water to caissons more than two hundred feet below the ground. My slump testing has covered three states and has represented over one million cubic yards of concrete.

My first experience with the truncated cone however was encountered while with the Pennsylvania State Highway Department in 1922.

Very sincerely yours,

(Signed) *M. A. Timlin*

Bobby's father was a highway engineer. His teacher, failing to get a satisfactory answer from several in his class in the defining of "cement," sought Bobby's assistance and received the following reply:

"Cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate and properly proportioned mixture of argillaceous and calcareous materials with no addition subsequent to calcination except water and calcined or uncalcined gypsum."—*Exchange.*

Joe, the Mixer Boss.

With the Manufacturers

INDUSTRIAL LITERATURE

Koehring Handbook

The Koehring Company, Milwaukee, Wisconsin, has again issued a new edition of its handbook "*Concrete—Its Manufacture and Use,*" with completely revised contents.

Tables on quantities of materials required are entirely new and all matter has been brought up to date. In spite of the fact that "it is not a finished exposition of methods employed in all types of construction," is constitutes a highly valuable book for contractors, foremen and superintendents, engineers, and architects. The present index is an improvement over those of even the previous editions.

A request will secure a copy.

Curing Booklet

The recently issued 1927 booklet on the curing of concrete pavements with silicate of soda, published by the *Grasselli Chemical Company,* Cleveland, Ohio, contains a number of new chapter headings, among them "Efficiency," "Simplicity," "Economy," and "Tests on Concrete Cured with Grasselli 'R-B' Silicate of Soda."

Huron Cement

The Huron Portland Cement Company, Detroit, Michigan, is distributing folders containing tables and curves of strengths secured with "*High Grade*" *Huron* cement in three days. A table of basic mixtures is given.

Canada Cement Publication

The Canada Cement Company, Limited, Montreal, Canada, publishes an attractive booklet known as "*Municipal Improvements*" and containing a number of descriptions of Canadian construction jobs of interest.

Chuting Plant Book

"*Lakewood Concrete Placing Equipment*" is a 68-page book received from the *Lakewood Engineering Company,* Cleveland, Ohio, and featuring three types of chuting plants. Some text is devoted to the types of plants, advantages of the chuting plant, and its permanency. A dozen or so illustrations of plants on the job are shown. Drawings show details. Other products such as hoppers, mast plants, concrete buckets, cars, clam shells and mixers are also included.

Heater Folder

A new folder published by the *Hauck Manufacturing Company,* Brooklyn, New York, shows concrete heaters burning kerosene or furnace oil for stationary drum mixers of all kinds, heaters with adjustable tank-burner support, for mixers of 10 cu. ft. capacity or under, and heaters for three specific makes of mixers, with or without loaders.

Oil-burning salamanders are also shown.

Notes From the Field

Chain Belt Buys Mixer Line

The mortar and plaster mixer business of the *Atlas Engineering Company* has been purchased by the *Chain Belt Company,* of Milwaukee, Wis. This is the second manufacturing business the company has bought within a year, the *Stearns Conveyor Company,* Cleveland, Ohio, manufacturers of belt conveyors, having been taken over eleven months ago. In buying the mixer business of the *Atlas Engineering Company* a complete line of mortar and plaster mixers will be added to the *Rex* line of concrete mixers.

The Atlas Engineering Company was organized 16 years ago and during the past three years the company made considerable progress in its mixer business under the direction of *H. W. Zimmermann.*

The Chain Belt Company was organized in 1891 by *C. W. Levalley* as a chain business. Later engineering and conveying lines were added and in 1907 the manufacture of *Rex* concrete mixers was started. The company operates two plants in addition to that at Cleveland, one at 11th Ave. and Park St., Milwaukee, and another at West Milwaukee where the engineering building, concrete mixer building, and malleable iron foundry are located. The engineering building was erected in January of this year and is the third major unit to be erected on the company's 59 acre tract. Branch offices are maintained in 16 principal cities.

Four other companies are affiliated with the *Chain Belt Company*—the *Federal Malleable Company, Sivyer Steel Casting Company, Interstate Drop Forge Company* of Milwaukee, and the *Nugent Steel Casting Company* of Chicago.

"P's and Q's"

The October issue of "*Silicate P's and Q's,*" published by the *Philadelphia Quartz Company,* Philadelphia, is devoted to the use of silicate of soda in concrete road curing. It goes into quite some detail, telling how silicate is used as a hardener and as a protection to freshly laid concrete.

Admixture Broadside

The Celite Products Company has published a broadside 18 by 27 inches on which appears a facsimile letter from a Detroit contracting engineer telling how concrete containing the admixture was chuted a considerable distance. Strengths on the job averaged 3,200 lbs. per square inch for concrete which was designed for 2,000 lbs.

Cinder Block Book

The holder of the Straub and Bo cinder block patents, the *National Building Units Corporation,* Philadelphia, has completed the publication of a 36-page book giving general information regarding the product and its uses.

The book presents a list of outstanding features of cinder block, illustrations of structures in which it has been used, charted findings of weight per cubic foot and wall efficiency, as well as tables showing results of tests of compression, freezing, and holding strength of wire nails. Following these are specifications for construction, including numerous detail blueprints.

Convenient Reference Tables

The North American Cement Corporation is distributing reference tables for concrete and for mortar printed on board in attractive form and suitable for hanging on a wall for the sake of easy reference.

The following heads are found among the tables of concrete-making references: Table of recommended concrete mixtures, water cement ratios, volume of water generally necessary, dimensions of bottomless measuring boxes of various capacities, materials for 1 cubic yard of mortar and concrete, materials required for 100 sq. ft. of walls, floors, sidewalks or any slabs, standard specifications for portland cement, average weights of aggregates, schedule of safety for cold weather, and areas of round and square reinforcing rods.